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THE EFFECT OF CHEMICAL TREATMENT ON INTRASPECIFIC RELATIONS IN MELOLONTHA HIPPOCASTANI F. (COLEOPTERA, SCARABAEIDAE)

V. M. BEREZINA

Many workers have recently become interested in the side effects of continuous chemical treatment in pest control. Particular attention has been paid to phenomena associated with the reorganization of biocoenoses, due in this case to the destruction, along with the pest against which the measures were directed, of other insects, including useful insects which acted as a check to the development of the harmful entomological fauna (Stark, 1954, 1957; Vereshchagina and Vereshchagin, 1955; Bovey, 1955; Hinton, 1955; Solomon, 1955; Cramer, 1955, 1956, 1957; Viltorov, 1956; Beglyarov, 1957, etc.).

At the same time it often happens that in destroying one forest pest, we guard against attack by other insects, or by fungal or bacterial infections that attack weakened trees. One can cite as examples the large-scale fungal contamination by Polyporus dryophilus, Fomes robustus and Vuillemilia comedeus observed in the 1950's along the outskirts of oak plantations in the Saval'skiy forests (Voronezh region) and the infestation of birches by Agrilis viridis L. associated with annual attacks on the leaves by Melolontha hippocastani F. A similar role is played by the larvae of the same pest or of M. melolontha, whose attacks on roots often expose fruit trees to infection by bacterial cancer (Mikhaylovskiy, 1950, 1951), pines to leaf-cast (Kashin, 1954), root fungus (Negrutskiy, 1955), or infestation by bark beetles (Popov, 1931; Stark, 1957), weevils and longicorn beetles (Berezina, 1957b), woodwasps (Stark, 1957) and other trunk pests. In reducing the numbers of May beetles in plantations by various means, including chemical pest control measures, we can also restrict the development of foci of various concomitant pests and tree diseases.

The discovery by Telenga (1956, 1957, etc.) that insects are more subject to muscardine infection when crops have been treated with hexachloran is worthy of considerable attention: I noticed the same development in relation to the larvae and eggs of Melolontha hippocastani F. after the Saval'skiy forest had been dusted with 5.5% DDT in 1953.

These facts only concern man's interference by chemical means with the relations between species in biocoenoses. At the same time it is no less important to examine certain of the effects of these same measures on intraspecific relations in the species against which they are directed.

The case is known, for example, in which, after the Kamennaya Steppe forest belts (Voronezh region) had been successfully treated against gypsy moth by DDT oil-emulsion spraying in 1952 and 1953 and by dusting with 5.5% DDT in 1954, the individuals to survive produced extremely fertile and viable progeny as a result of the reduction in the population, since the food supply for the caterpillars was greater than would have been the case in the absence of control measures (Edel'man, 1957).

I discovered a feature that was no less typical and that was fundamentally of the same order when developing chemical measures for the control of M. hippocastani during the period of adult feeding.

In the Saval'skiy forest these studies were carried out on four broods in the May beetle population. Before chemical treatment was commenced, two of them, the beetles of which flew in 1952 and 1953, were on a large scale, while the other two, the beetles of which flew in 1954 and 1955, were relatively weak.

Aerial dusting with 12% hexachlorancyclohexane (20 kg/ha) was used against the beetles of the first trong brood in 1952. The second was dusted with 5.5% DDT dust in 1953 at the same rate, but this chemical was ineffective and the beetles had to be retreated in 1957, the year of their flight, with hexachlorancyclohexane. Only one of the weak broods was dusted with hexachlorancyclohexane in 1954 and 1958, and the treatment, which was carried out very late, was confined to the outskirts of the plantations; no measures were undertaken against the other brood, the beetles of which flew in 1955 and 1959. The effect of the treatment was then estimated yearly from 1951 to 1959 inclusive by taking 300-350 soil samples 1 meter square to a depth of 0.5 m from selected sites and comparing the average number of specimens per square meter from each brood before and after dusting. In order to eliminate possible errors due to difference in the age-class composition of the pest and consequent underestimation of natural decline during the development of the separate broods, the population dynamics of the lines were compared at intervals corresponding to the duration of the life cycle, thus ensuring that the figures for age-class composition for each brood were comparable.

It is shown in Table 1, as has already been mentioned, that dusting with DDT in 1953 was ineffective, and that the number of representatives of the second generation was even subsequently increased. Dusting with hexachlorancyclohexane in 1952 (against the first brood) and especially in 1957 (repeat treatment against the second brood), on the other hand, killed large numbers of the beetles, so that both broods, but especially the second, had become weak by the 1959 count.

The situation was different with the broods that had been small in numbers before the treatments. Thus, despite two treatments with hexachlorancyclohexane in 1954 and 1958, which were admittedly confined to the outskirts of the plantations, the number of specimens of the third brood increased by 160% in the second generation (i.e., the 1955 count) and was 510% of the initial (1951) figure by the third generation (the 1959 count). There had been hardly and increase in the numbers of the weakest (the fourth) brood by the second generation (the 1955 count), but there was a considerable leap in the third generation, to 874% of the initial figure by 1959.

There was thus a marked change between 1951 and 1959 in the percentage ratio of the different broods in the Saval'skiy forest. This, as we have seen, was due both to the destruction of a large part of the beetles in the strong broods by chemical treatments and to simultaneous increase in the number of representatives of the former weak broods. That this regrouping was in fact due to chemical control measures can be seen if we compare it with similar figures for the same period in a small May beetle pocket at Zhanuvarovo, 10 km from Saval'skaya dacha, which was not given chemical treatment (Table 2).

The position at Zhanuvarovo in 1959 by comparison with 1951 differed from that at Saval'skaya dacha: there was a considerable increase in the first brood (which had been a strong brood all along), a decrease in the second brood, almost total disappearance of the third and the appearance of a fourth brood, which had not previously existed. Particular attention should be paid to the fact that as the first brood increased almost one and one half times the third practically disappeared and that a fourth brood appeared, admittedly in small numbers, as the third declined. This gives the impression that there were antagonistic relationships between the broods that did not fly in successive years. If Table 1 is considered in this light one also finds

Table 1

Dynamics of the numbers of separate broods of the May beetle in relation to chemical treatment (numerator—mean infestation per square meter, denominator—percentage of the number before treatment)

Year of count	First brood, flying in 1952 and 1956	Second brood, flying in 1953 and 1957	Third brood, flying in 1954 and 1958	Fourth brood, flying in 1955 and 1959
	3rd instar	2nd instar	1st instar	Eggs
1954 . . .	5.9/100	4.3/100	2.0/100	0.5/100
1955 . . .	3.9/66	11.8/275	5.2/260	0.6/120
1959 . . .	2.6/44	0.6/14	10.2/510	4.3/874

Table 2

Dynamics of the age-group composition ratio of the May beetle with and without chemical treatment

Year of count	Saval'skaya dacha				Zhanuvarovo			
	First brood	Second brood	Third brood	Fourth brood	First brood	Second brood	Third brood	Fourth brood
	1st instar		1st instar	Eggs	3rd instar	2nd instar	1st instar	Eggs
	Before chemical treatment							
1951	46%	34%	16%	4%	55%	24%	21%	0%
	After chemical treatment				Without chemical treatment			
1959	15%	3%	58%	24%	83%	14%	0%	3%

that the decrease in the numbers of the first, formerly strong brood is matched by an increase in the third, formerly weak brood. This relationship only becomes apparent in the second and fourth broods (Table 1) after the highly effective retreatment with hexachlorancyclohexane, when the decrease in the level of infestation by the second brood was matched by a sharp increase in the fourth brood. Unsuccessful dusting of this brood with DDT in 1953 did not produce this reaction in the fourth brood, possibly because it was poorly represented.

It is significant that Bowien (1938) reported that under Danish conditions it was the brood separated by a period of two years that overtook a former strong brood.

It must, however, be stressed that all our studies connected with the development of chemical control measures for M. hippocastani were made at a time when the soils were highly infested with these pests, the average being 12 larvae per cubic meter and the maximum 216 (among pines). The numerical regroupings consequent upon man's effective interference with the balance of the populations which we have observed once again prompt the thought that cannibalism may have occurred in this case: this idea was first advanced in the late 19th century to account for the formation of strong broods in M. hippocastani, but was subsequently rejected by leading Russian and foreign entomologists. Nevertheless, one must note reports by Ogiyevskiy (1908, 1916) to the effect that 3rd instar larvae are predators of 1st instar larvae, but do not touch either their coevals or the 2nd instar larvae. These reports are worthy of attention in the light of our facts as set out above.

We must also deal with another, extremely fundamental aspect of the coexistence of different lines and therefore of different instars in the soil, namely the problem of nutrition. Firstly, there is some point in noting that Zweigelt (1928) has reported that the onset of the flight period for May beetles is always late in the year following a swarm year, a fact which he tentatively explained by general retardation in development due to the weak physiological state of the individuals in broods that are not plentiful. Moreover, Robert (1953) reports in a recent paper that when a meadow soil is heavily infested with M. melolontha the number of beetles to fly from it is less than when the soil is lightly infested. In his opinion this is due in part to lack of food, which particularly affects 3rd instar larvae in dry years, when they may even pupate but when many of them will not have sufficient reserves to support life on becoming beetles. Larvae may not always be able to survive the competition of other larvae of the same age, but younger larvae living in association with fully grown larvae should be even less likely to do so. Subsequent studies have revealed that the quality of the food may be no less important a factor than its quantity. This latter question is, of course, not new and there is a copious literature devoted to it, but it is a special feature of the nutrition of Melolontha sp. larvae in standing timber that the composition of their food is dependent both on the species, age and growth conditions of the food trees and on the extent to which the larvae feed on their roots, and therefore on the number and age-group composition of the larvae.

The effect which the gnawing of tree roots by Melolontha sp. has on their total content of nitrogen and sugars and the importance to the larvae of fluctuations in the amount of these substances in their food was the subject of studies which I made in the Saval'skiy forest between 1951 and 1959. The results of these studies have been published in part (Berezina, 1957a) and the following conclusions were drawn.

When larvae in the last instar predominate in the population the total content of nitrogen and sugars in the roots falls and this has an adverse effect on the larvae that feed on them. When eggs or 1st instar larvae predominate the qualitative indices for the roots are improved and this improves the condition of the larvae that feed on them. Deterioration in the quality of the food mainly affects those larvae that have the greatest influence on the process—the individuals of the strong broods. After pupation, i.e., at a time when feeding is most intensive but when it is the weak broods that are feeding, the roots make good their losses (at a different rate in each species of tree) and the quality of their food has once again improved by the time that the progeny of the strong broods hatch.

The situation is different for the larvae of weak broods. When young they feed in company with the fully grown larvae of the strong broods and are forced to make do with food of inferior quality. It is only at a later stage, when their

numerous older confreres in the association are on the point of pupation, that the quality of their food improves. But, since it is a known fact that young organisms react more strongly to the quality of their food than do adults, this transition is not capable of effecting a noticeable improvement in their physiological condition or of increasing their fertility. All this goes a long way towards explaining why the numbers of weak broods continually lag behind and also why two swarm years usually follow each other instead of alternating with years in which the beetles do not swarm.

When the numbers of strong broods are reduced by chemical or other means, we both reduce the number of encounters between adult larvae of these broods and their prey, the 1st instar larvae of the weak broods, and improve the feeding conditions of the latter larvae. This improves their physiological condition and fertility and enables them to effect the transition from weak to strong broods within 2-3 generations. I mentioned at the beginning of the paper that this happened in the Saval'skiy forest with the third brood (Table 1) and we have now had to plan to treat it with hexachlorancyclohexane in 1962. The same fate will probably await the fourth brood some four years later. The former strong broods have now become weak broods and are being repressed by the broods that they formerly repressed.

These changes in the interrelationships of separate broods of May beetles, brought about by chemical treatment, can also occur without man's intervention, but such cases should be as rare as, in general, are changes in the swarm years of May beetles. Nevertheless, it is my opinion that such changes hold the key to one of the main methods by which the species maintains both itself and the extreme stability, over a period of several decades, of its foci, a clear example of which is provided by its foci in the Buzuluk (Orenburg region) and Khrenov (Voronezh region) pine forests, the persistence of which has been known since the beginning of the century (Berezina, 1960).

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THE STRUCTURE OF THE INSECT BRAIN AT SUCCESSIVE STAGES IN POSTEMBRYONIC DEVELOPMENT. 4. THE OLFACTORY CENTER

A. A. PANOV

The deutocerebrum of the insect brain includes the sensory and motor centers of the antennae. The motor center (dorsal lobe) innervates the musculature of the basal antennal segments and the musculature within the head capsule around the scape. The sensory center (olfactory lobe) is entered by nerves composed of the proximal processes of the sensory cells on the flagellum of the antenna and on its two basal segments. There may be two sensory nerves (as in the Ephemeroptera and Blattodea, for example) or only one (as in the Odonata, certain Plecoptera and Mantodea [Hanström, 1940]).

In a number of cases (Ephemeroptera, Odonata, Plecoptera and certain others) the neuropile of the olfactory center is homogeneous. For the most part, however, the olfactory center is composed of a neuropile consisting of large glomeruli. Studies in which the brain was impregnated with silver (Kenyon, 1896; Jonescu, 1909) show that the glomeruli are the points of contact in the fibrous matter of the center between the terminal ramifications of the proximal processes of the sensory cells of the antennae and the ramifications of the processes of the brain neurones. The existence of glomeruli in the olfactory center is normally related to the high level of development of the sensory apparatus of the antennae.

The level of development of the olfactory center is not the same in different insects, either in the adult state or in the preimaginal period. In my studies of newly hatched "Polyneoptera" nymphs (Blattella germanica L., Ameles taurica Jak., Dixippus morosus Brunn., Metrioptera sepium Jers. and Calliptamus italicus L.) I have found that the structure of the sensory antennal center is similar to that of the imago and only increases subsequently in volume. This complete development of the olfactory center is clearly connected with the fact that the newly hatched insects are already in possession of multiarticulate antennae with a great many sensillae.

My studies have also shown that the sensory antennal center in the newly hatched larvae of the Mayflies Ephemera vulgata L. and Heptagenia fuscogrisea Retz. has the same structure as the olfactory lobe in the adult insect, since the structure of the deutocerebrum is extremely simple in the larvae, nymphs and imago of Mayflies and consists of a small swelling of homogeneous neuropile below the fibrous matter of the protocerebrum. In this case the only changes undergone by the deutocerebrum in the postembryonic period are connected with increase in size as the brain as a whole increases in size.

I have found that the structure of the olfactory center is extremely simplified in certain newly hatched "Oligoneoptera" larvae (Apis mellifica L., Anthonomus rubi Hrbst., Ascalaphus sp. Culex pipiens L.). In these species, as in Mayflies, the sensory antennal center is a small anterolateral prominence of fibrous matter at the beginning of the para-oesophageal connective. Hanström (1925) had earlier found that the structure of this center was similar in the newly hatched caterpillar of Pieris brassicae L. The deutocerebrum may, however, be even simpler in structure but I have not been able to detect any generalized deutocerebrum in the newly hatched larva of Musca domestica L.

On the other hand I was able to detect the glomerular structure of the fibrous matter of the olfactory lobe in newly hatched Tenebrio molitor L.and Chrysopa sp. larvae.

The neuropile of the deutocerebrum increases in size throughout the larval period. In the honey bee and the cabbage white the neuropile of the olfactory lobe remains homogeneous, apparently because the number of sensory elements on the antennae remains limited in these species throughout the larval period (Hanström, 1925). In beetles, the existence of glomeruli in the olfactory center of adult larvae has been established for a great many species by the work of Bretschneider (1914), Beier (1927) and Jawlowski (1936). Unfortunately, these works do not state whether olfactory glomeruli are present in the brain of the newly hatched larvae or whether they only develop during the larval period. According to Bretschneider, the olfactory glomeruli disappear from Tenebrio molitor L. in the prepupal stage and are replaced by imaginal glomeruli at the close of the pupal stage.

Thus one can tentatively distinguish two developmental types for the olfactory center in the Oligoneoptera. In butterflies and the Hymenoptera, in which the neuropile of the larval sensory center is homogeneous, glomeruli first appear at the pupal stage and only attain full development in the imago. In some other insects, such as beetles for example, glomeruli are present in the larval brain and have clearly developed in the embryonic period. These glomeruli are destroyed in the prepupal stage but reappear during pupation.

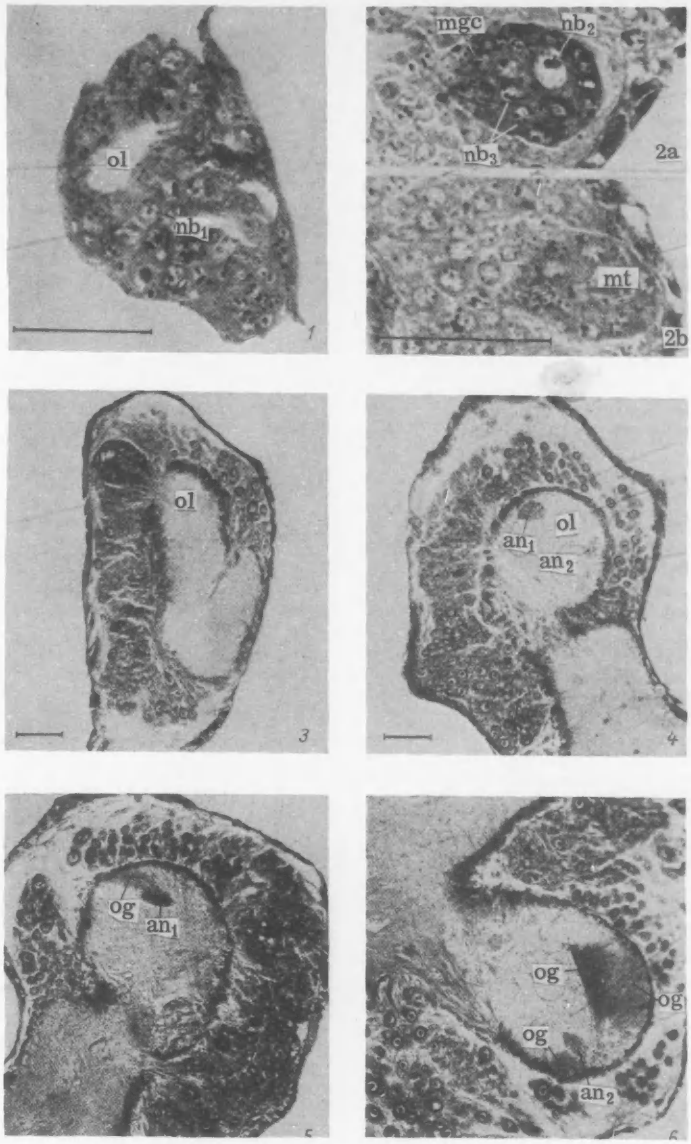
We shall now consider these two types of development in greater detail. We shall take the honey bee as an example of direct development in which glomeruli only develop once, and the sensory antennal center of the flour beetle as an example of the second type of development. In the latter case we shall pay particular attention to the development of the olfactory center in the prepupal and pupal stages.

DEVELOPMENT OF THE OLFACTORY CENTER IN THE BEE

Sources of increase in the number of deutocerebral neurones. In bees the associative neurones of the olfactory center are increased in number both by the activity of isolated neuroblasts, large numbers of which are present in this area of the brain, and by a center consisting of several neuroblasts which proliferate nerve cells. The isolated neuroblasts (Fig. 1, nb_1)[1], like those of the rest of the brain, continue to divide and give rise to daughter neuroblasts and mother ganglion cells until the second day of pupation.

In the newly hatched larva the center of proliferation consists of a small number of neuroblasts in front and to one side of the larval olfactory center in the form of a distal continuation of this center. The neuroblasts of the center are very similar to those of the rudimentary mushroom bodies of the bee. They are finer than the isolated neuroblasts

[1] The following abbreviations are used in Figs. 1-18. an_1—greater internal tract of sensory fibers of the antennal nerve; an_2—lesser internal tract; deg—degenerating associative neurones of the olfactory lobe; mgc—mother ganglion cell; nb_1—isolated neuroblast; nb_2—large neuroblast of the center of proliferation in the honey bee; nb_3—ordinary neuroblast of the center of proliferation; nc_1, nc_2—deutocerebral nerve cells of the flour beetle; ol—olfactory lobe; og—olfactory glomerulus; og_1, og_2, og_3—successive stages in the disentegration of olfactory glomeruli; 1, 2—a group of associative cells of the olfactory lobe in the flour beetle. The line by each microphotograph is 50 μ long.

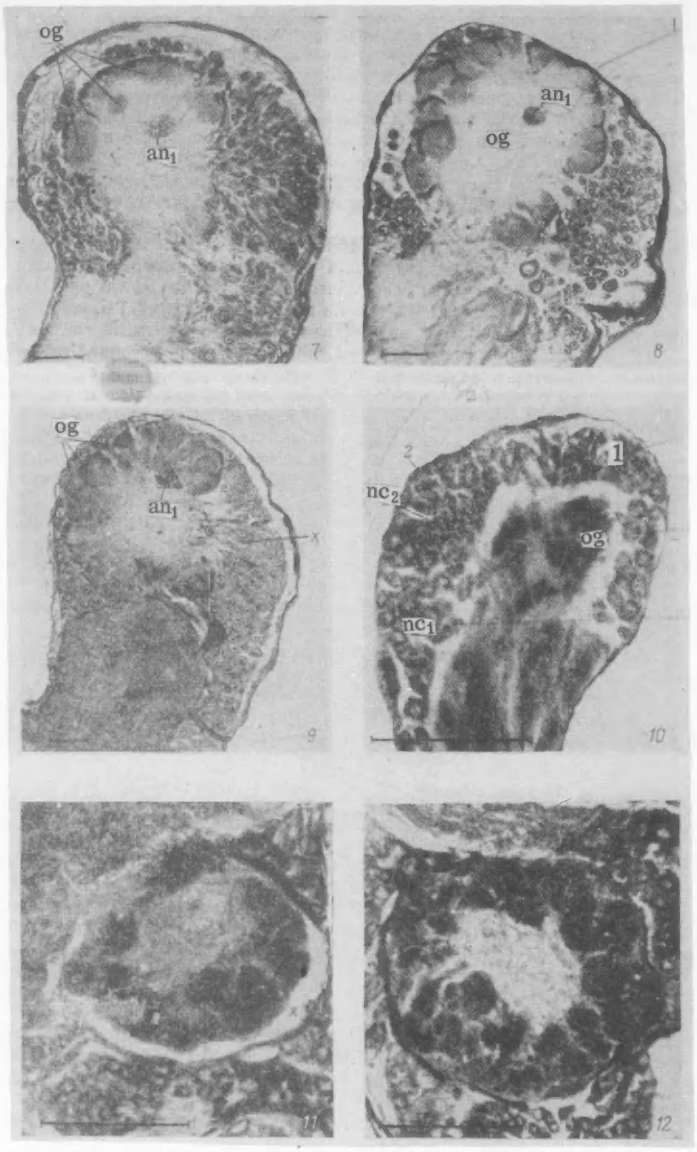


Figs. 1 - 6:- 1 - Horizontal section through the right deutocerebral region of the brain of a day-old Apis mellifica L. larva; 2a and 2b - a neuroblast cluster in the deutocerebral region of the brain of an A. mellifica L. larva; 3 - horizontal section of the left deutocerebral region of A. mellifica L. on the first day of the prepupal stage; 4 - horizontal section of the left deutocerebral region of A. mellifica L. on the first day of pupation; 5 - horizontal section of the right deutocerebral region of the brain of A. mellifica L. on the second day of pupation; 6 - sagittal section of the deutocerebrum of A. mellifica L. on the second day of pupation (anterior surface of the brain on the right).

(the average diameter of the nucleus in an isolated neuroblast in a day-old larva is 7.8 μ, while that of a neuroblastic nucleus in the deutocerebral cluster is 5.8 μ) and contain less plasma, which, however, strains more rapidly than does the plasma of isolated neuroblasts.

In the first two days of larval life the center consists of several such neuroblasts and a few mother ganglion cells. By the third day one of the neuroblasts increases in size and becomes as large as an isolated neuroblast. The center of proliferation continues to exist until the fourth day of pupation as a large neuroblast (Fig. 2a, nb_2), a few of the ordinary neuroblasts of the cluster (nb_3), which increase considerably in number in the course of the larval and prepupal periods, and mother ganglion cells (mgc). Between the fourth and fifth days of the pupal stage it disappears in the same way as the neuroblast clusters in the optic lobes.

The large neuroblast is always situated in the center at the point farthest from the neuropile of the olfactory center



Figs. 7 - 12: - 7 - Horizontal section of the right deutocerebral region of the brain of Apis mellifica L. on the fourth day of pupation; 8 - horizontal section of the righthand side of the deutocerebrum of A. mellifica L. on the seventh day of pupation; 9 - horizontal section of the right deutocerebral region of an adult worker A. mellifica L.; 10 - horizontal section of the left deutocerebral region of a newly hatched Tenebrio molitor L. larva; 11 - frontal section of the olfactory lobe of an adult T. molitor L. larva (the antenna corresponding to the lobe was removed 18 days before fixation); 12 - ibid (the non-operated side).

and is surrounded on three sides by ordinary neuroblast cells and on the side of the fibrous matter by mother ganglion cells. The latter also occur singly among the ordinary neuroblasts.

The neuroblasts of the cluster divide in two ways. Even mitotic division gives rise to two daughter neuroblasts and uneven mitosis to a neuroblast and a mother ganglion cell.

The large neuroblast is similar to the isolated neuroblasts both in dimensions and in the structure of the cytoplasm, which is vacuolated in both cases. The large neuroblast always divides unevenly, sending out the mother ganglion cells proximally (Fig. 2b, mt). In the majority of cases there is a single large neuroblast in each center of proliferation. I have only once found two such neuroblasts in a single center of proliferation in a one-day prepupa.

The neuroblasts of the center of proliferation of the nerve cells of the olfactory center are considerably less active than those of the centers of proliferation in, for

example, the mushroom bodies. Although the deutocerebral center in a one-day larva contains more neuroblasts than the rudiments of each globulus of the mushroom body it never attains the same dimensions as the centers of proliferation in the latter and there are fewer nerve cells in the deutocerebrum than in each globulus of the mushroom body.

Thus cells of three sizes, corresponding to mitoses of three dimensions, are found at the center of proliferation of the nerve cells of the olfactory center. Genetically speaking, however, one can, as always, only distinguish two groups of cells—neuroblasts and mother ganglion cells. In the first group one differentiates between the large neuroblast, which always divides unevenly, and ordinary neuroblasts, which divide evenly or unevenly. It is not possible to make the same distinction as in the neuroblast clusters of the optic lobes between zones in which the number of neuroblasts increases and zones in which mother ganglion cells are formed.

The largest cell group in the olfactory lobe, which lies to one side of its neuropile in the imago (Fig. 9, X) is formed by the activity of the center of proliferation. The cell fibers of this group join the neuropile in a wide tract at a point which is always free from olfactory glomeruli. The activity of the isolated neuroblasts gives rise to the countless groups of cells that surround the olfactory lobe of the adult bee on almost all sides.

Formation of the imaginal structure of the neuropile of the olfactory lobe. In the newly-hatched larva the deutocerebrum lies slightly above the oesophagus and has the appearance of a papilla which apparently rests on the paraoesophagal connective with its apex pointing forwards and to the side (Fig. 1, ol). It is so small that it can only be detected on one 5 μ section as an open network of fibers. The antennal nerve, which is encased in neuroglial cells, emerges from a point near the apex. At this stage in development it is extremely short since the brain is immediately adjacent to the base of the extremely simple larval antennae.

The deutocerebrum of a newly-hatched larva cannot be divided into olfactory and motor centers, although the apical section of the neuropile papilla can already be treated as an olfactory lobe of extremely simple structure, inasmuch as it is entered by the fibers of the sensory neurones of the larval antennae.

The neuropile of the deutocerebrum grows intensively and alters its shape considerably by the fourth day of larval life. Since growth of the neuropile is primarily concentrated in the apical section of the papilla, the latter becomes rounded in horizontal sections and ceases to be conical. One can already distinguish quite clearly the site of the future contraction which separates the olfactory lobe from the remainder of the neuropile in the imago. The olfactory lobe increases in size while retaining the same shape for the remainder of the larval period and in the first prepupal day (Fig. 3, ol).

By the second prepupal day, however, the neuropile of the lobe has grown so much that it becomes inversely pear-shaped in horizontal sections (Fig. 4, ol). One can see from sagittal sections at this time that the olfactory lobe is beginning to grow upwards towards the protocerebral lobe and downwards into the tritocerebral region. Thus the spherical shape of the olfactory lobe so typical of the brain of the adult insect begins to be formed in the prepupal period.

The nature of growth in the neuropile of the olfactory center remains the same throughout the period of pupal development, but downward growth predominates. This lowers the olfactory lobe practically to the level of the tritocerebral division of the brain, which now no longer lies beneath the deutocerebrum, as was the case in the newly hatched larva, but is medially situated only slightly below it.

The rudiments of the imaginal antennae develop with extreme rapidity in the prepupal period and by the second day of the prepupal period the fibers of the antennal sensory cells have grown into the olfactory lobe by the same pathway as was previously followed by the processes of the larval antennal neurones, which have now died. Quite thick tracts of these fibers can be seen to penetrate the olfactory lobe from the underlying surface beneath the cluster of neuroblasts on the second prepupal day. At the point of entry into the olfactory lobe the nerve divides into two branches. The thickest of these two branches follows the front edge of the lobe upwards, making close contact on the inside with the neuroglial cells that surround the neuropile on all sides (Fig. 4, an_1). On attaining the apical edge of the neuropile this branch follows the contours of the lobe backwards for some distance before terminating in a network of fibers that are finer and more openly spaced than in the tract proper.

The second branch runs from the point of bifurcation to the medial edge of the lobe, crossing its neuropile almost diagonally (Fig. 4, an_2). On attaining the medial surface of the fibrous matter, the tract ascends slightly and becomes more open. This second branch, which is finer than the first, is known as the lesser internal tract of the sensory fibers, while the first branch is known as the greater internal sensory tract (Jawlowski, 1948). The third, ventral tract of sensory fibers cannot be detected in the prepupa and only becomes clearly visible on the second day of pupation, when it is already quite thick.

In the prepupal period the neuropile of the olfactory lobe is homogeneous throughout, except for the tracts here mentioned. Olfactory glomeruli first appear on the second day of the pupal period. The greater internal tract of sensory fibers stands out somewhat from the anterior surface of the neuropile of the olfactory lobe in cross-sections of the deutocerebrum in a pupa of this age. Fibrous matter which stains considerably better than the central sector of the lobe (Fig. 5, an_1, og) lies between the lobe and the tract. Sagittal sections show that a strip of consolidated neuropile of this type runs ahead of the greater tract throughout its length. At this time there is also consolidated neuropile in the inferoposterior sector of the olfactory lobe, where it is associated with the ventral tract of sensory fibers (Fig. 6, an_2, og).

The formation of glomeruli proceeds unremittingly from this moment. On the fourth day of pupation they practically cover the surface of the olfactory lobe, but are most highly developed on the inferoposterior surface (the region of the ventral tract) and especially on the upper anterior surface (the region of the greater internal tract; Fig. 7, an_1, og). The glomeruli are less developed along the internal surface of the lobe in the region of the lesser internal tract.

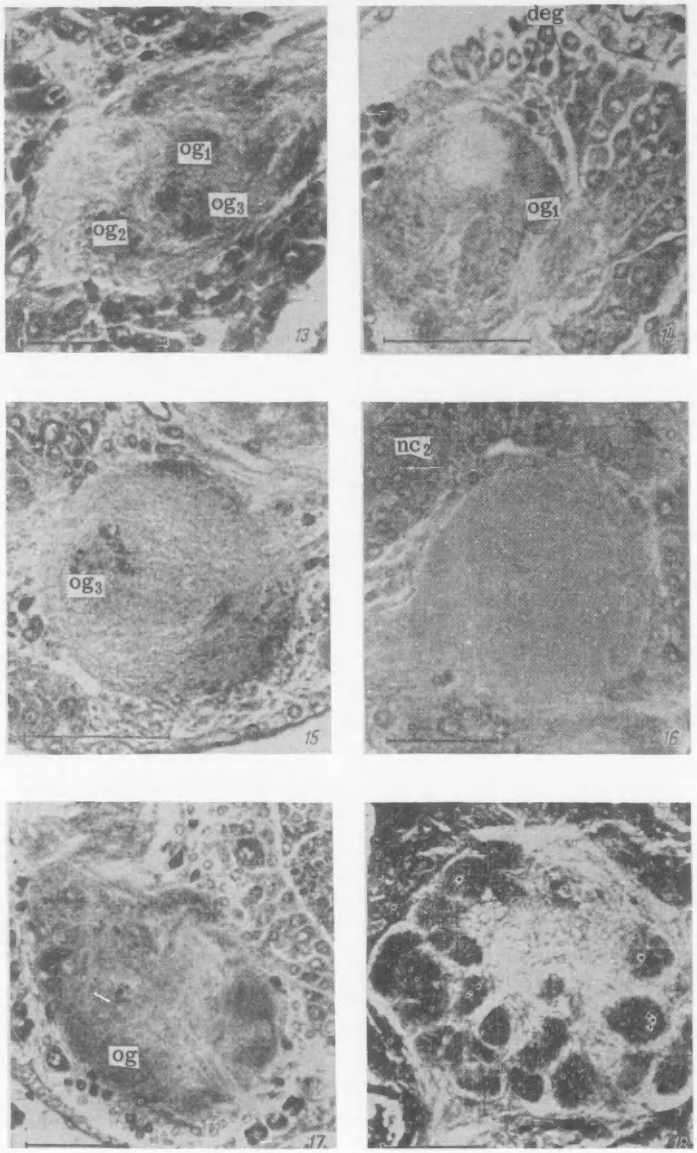
The glomeruli in the olfactory lobe of the bee do not develop by consolidation of neuropile that was in existence before their appearance but by the outgrowth from the surface of the lobe of fibrous matter that is from the outset more consolidated than the fibrous matter of the center of the olfactory lobe. We are convinced of this by the change in the position of the greater internal tract of sensory fibers, which was initially disposed outside the neuropile of the lobe but which, by the close of the pupal period, lies within its fibrous matter and is separated from the surface by a row of glomeruli (Figs. 4-6; Figs. 7-9, an_1). Since it is difficult to assume that a tract of nerve fibers migrates within the olfactory lobe, one can only presume that a new glomerular neuropile grows in front of the tract.

Initially the surface layer of the consolidated neuropile is poorly divided into glomeruli. Later further consolidation of the neuropile may cause each of the initial glomeruli to divide into two or three parts, which are olfactory glomeruli in their final form (Figs. 7-9, og).

DEVELOPMENT OF THE OLFACTORY CENTER IN THE FLOUR BEETLE

The olfactory lobe already has a glomerular structure in the newly hatched larva (Fig. 10, og). As in the adult insect, the majority of the glomeruli are peripheral, but they are considerably smaller than in the imago. Two groups of cells enclose the fibrous matter of the lobe. Fibers of cells of each of these two groups form a tract and enter the neuropile of the lobe together at a definite point. One such point of entry for the cell processes is situated on the inferoanterior surface of the lobe and another on the upper lateral surface. Since the section shown in Fig. 10 was cut at an angle, it reveals both points of entry of the fibers at the same time (1, 2). Both points of entry are never simultaneously revealed on correctly angled cross sections in the horizontal, frontal or sagittal planes.

Both groups of cells are of similar composition. The larger cells are peripherally disposed (nc_1). Their nuclei are spherical and 5-6 μ in diameter. There is a fair amount of chromatin in the nucleus, so much that the nucleolus is obscured.



Figs. 13 - 18: - 13 - Frontal section of olfactory lobe of T. molitor L. prepupa with four rows of pigmented ommatidia; 14 - horizontal section of olfactory lobe of T. molitor L. prepupa with four rows of pigmented ommatidia; (a somewhat later stage than that depicted in Fig. 13); 15 - frontal section of the olfactory lobe of T. molitor L. on the second day of pupation; 16 - frontal section of the olfactory lobe of T. molitor L. on the sixth day of pupation; 17 - olfactory lobe of T. molitor L. on the ninth day of pupation; 18 - frontal section of olfactory lobe of T. molitor L. imago.

In the center of the group the cells are of smaller dimensions, with an ellipsoidal nucleus and plasma that stains more deeply (nc_2). Finally, there is a large neuroblast, from which all the cells in the group apparently originated, between the small cells and the brain membrane.

The olfactory lobe is also entered by the fibers of the antennal nerve, the olfactory tract and the deutocerebral commissure.

The olfactory lobe increases greatly in size during the larval period, its glomeruli become considerably larger and the number of cells increases (Fig. 12). Nevertheless, as at the very beginning of postembryonal development, the nerve cells of the olfactory lobe in the adult larva remain aggregated in the two groups already mentioned, the composition of which remains unchanged. There is a neuroblast at the center of each group, surrounded by a great many small cells with little plasma, and a spherical nucleus in which the chromatin is gradated. Larger cells that are more plentifully supplied with plasma lie on the periphery of each group. The nuclei of the peripheral cells are larger than those that are more centrally situated and the chromatin in their nuclei is also gradated.

In the initial stages of the prepupal period of development the structure of the olfactory lobe remains unchanged. The first signs of destruction of the larval olfactory glomeruli appear in the prepupa, in which 2-3 rows of pigmented ommatidia can be discerned in the compound eyes. The structure of the fibrous matter in each glomerulus becomes coarser at this time. Whereas the neuropile of the glomerulus is extremely homogeneous in appearance in the adult larva, dots which stain more deeply appear in the glomeruli of a prepupa with 2-3 rows of pigmented ommatidia: these dots increase in number and size and coalesce. When there are four rows of pigmented ommatidia one can observe all the transitional stages from glomeruli that have only just begun to degenerate to those that have practically disappeared (Fig. 13, og_1, og_2, og_3). In the later stages of their breakdown, the glomeruli consist of large globules that stain readily and which subsequently decrease in numbers and disappear (Fig. 15, og_3). This process lasts for the first 6 days or almost half the pupal development period. During the breakdown of the glomeruli there is an overall contraction in the dimensions of the olfactory lobe.

No trace of the larval glomeruli can be detected in the olfactory lobe of the pupa at 6 days. The neuropile of the lobe is homogeneous and stains very lightly (Fig. 16). The dimensions of the lobe once again begin to increase. Imaginal olfactory glomeruli first begin to develop on the seventh day, both at the margin of the lobe neuropile and in its central sections, and appear initially as slightly consolidated areas of fibrous matter (Fig. 17, og). Consequently, the formation of the glomeruli is not the same in the flour beetle as in the bee, since the process is one of the consolidation of existing fibrous matter rather than of the growth of new areas of neuropile. Subsequently, as in the bee, the separate areas of the consolidated neuropile become differentiated into definitive glomeruli (Fig. 18).

As the larval glomeruli disappear there are considerable changes in the cell layer of the olfactory center. Firstly, the small cells at the center of each of the two previously mentioned groups of cells in the adult larva grow perceptibly until they equal in size the peripheral cells of the groups, and their plasma content increases considerably. In the pupa they can no longer be distinguished from the remaining cells in the deutocerebrum (Fig. 16, nc_2).

Secondly, in cells which appear in the peripheral layer of both groups the plasma is consolidated and stains more deeply than the plasma of the adjacent cells and the contents of the nuclei have coalesced into a single drop. The whole range of transitions from a completely normal cell to one which has been entirely converted into a globule that stains very deeply (Fig. 14, deg.) can be discerned in a set of cross sections. Degenerating cells first appear when the larva has 2-3 rows of pigmented ommatidia and are most abundant immediately before pupation and in the first few hours as a pupa.

The observed simultaneous disentegration of the larval glomeruli and the degeneration of the bodies of cells along the peripheries of both groups of neurones are two sides of the single process by which the larval nerve cells and the structures of the neuropile associated with them are replaced by imaginal forms. This change in structures, accompanied by the degeneration of nerve cells is clearly an invariable occurrence when the olfactory glomeruli are differentiated in the larval brain, as is the case, for example, in the majority of beetles.

Since the processes described above continue in the deutocerebrum after the disappearance of the larval antenna and the formation of the imaginal antenna, the question naturally arises as to whether the disentegration of part of the associative cells of the deutocerebrum and the olfactory glomeruli associated with them is caused by the degeneration of the sensory cells of the larval antennae or by something deeper.

It occurred to me that this question could be answered by the results of the simple operation of removing the antennae of an adult flour beetle larva. The operation was carried out (the right antennae were completely removed) on a number of larvae which were subsequently prepared for microscopy on the 18th day after removal of the antennae. The glomerular structure was found to have been retained on the side of the operation, but the dimensions of the lobe were greatly reduced. Thus, for example, in seven of the larvae used in the experiment, the volume of the olfactory lobe on the side of the operation was only 63% on average of the volume of the corresponding normal lobe. It was found in control measurements on two normal larvae that the volume of one lobe only exceeded that of the other by 10%. This result is probably due not to assymetry of the brain but to the fact that it is difficult to make an exact demarcation between the olfactory lobe and the rest of the brain on the frontal sections used in the measurements.

Owing to the contraction in the volume of the neuropile, the latter separates from the surrounding cells and a cavity is formed between it and the cells (Fig. 11, X).

These results are in good agreement with the findings of Titschack (1928), who demonstrated an overall contraction in the corresponding deutocerebral area of the brain immediately after removal of an antenna from a bedbug, and with the findings of Pflugfelder (1936-1937), who obtained similar results in experiments with various other bugs.

Direct formation of glomeruli immediately after the imaginal antennal nerve has made its connection with the lobe is not observed in the flour beetle, i.e., one fails to observe the phenomenon that is so clearly manifested in the honey bee. Here also, however, the appearance of glomeruli is governed by the joining of the olfactory lobe to the proximal processes of the sensory cells of the developing imaginal antennae. I am convinced of this by the effect of removing the antennae from young pupae, in which the neuropile of the olfactory lobes is still homogeneous. Structural development of the olfactory center is retarded in larvae operated on in this manner. The olfactory lobes of the adult beetles which emerge from pupae that have been operated on consist of homogeneous neuropile. The density of the fibrous matter is the same as in the glomeruli of the corresponding normal lobes. The dimensions of the lobes corresponding to removed antennae are less than the dimensions of the normal lobes.

Thus, the proximal processes of the sensory antennal neurones, around the terminal branches of which the glomeruli appear, are responsible for the development of form. If the processes of the sensory antennal cells are prevented in any way from penetrating to the brain, glomeruli are not formed in the brain.

The dendrites of the associative neurones of the deutocerebrum are capable of preserving the glomerular structure of the neuropile of the olfactory lobe when there is degeneration of the proximal processes of the sensory cells connected with them. They cannot, however, create a glomerular structure independently.

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A NEW SPECIES OF GALL MIDGE (DIPTERA, ITONIDIDAE) INJURIOUS TO BROME GRASS: SOME CHARACTERS OF ITS BIOLOGY

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Year by year sowings of awnless brome grass (Bromus inermis Leyss.) in the USSR become more extensive. A high-yielding fodder plant for farm animals, it grows throughout the European part of the Union, in Western and Eastern Siberia, in the Far East and in Central Asia.

Until recently the only gall midge larvae known to infest it were those found in the culms. A new species was discovered in 1956, when the Kursk State Agricultural Experiment Station was studying insect fauna harmful to these grasses. This species is a pest highly injurious to the reproductive structures of wild and cultivated awnless and upright (Bromus riparius Rehm) brome. Areas other than the Kursk Station lands where it has been found include the Medvensk and Oboyansk strain testing stations, sowings in the Leninsk district and the Alekhin Central Chernozem Park in the Kursk province. We have also found the larvae in brome seed samples collected at the field experiment station of the Timiryazev Academy of Agriculture, Moscow.

Gall midge damage to the fruit parts of awnless brome amounts to 40-100 per cent in certain years and to 60 per cent in the case of upright brome. The larvae destroy the minature ovary and the contents of immature achenes in process of formation.

When newly hatched the larva is hyaline, shining and mobile; when full-grown, it is yellow and 1.5 to 2 mm long. In the pupa, head, thorax, antennae and legs are covered with a dark chitin; the abdomen is mobile and enclosed in a hyaline sericeous cocoon. Pupation occurs when the larva feeds. Before emergence, the pupa parts the paleae to facilitate the midge's emergence.

The diapausing larvae overwinter in the puparium in damaged flowers and seeds shed in the field, in refuse and in storehouses, retaining their viability for as much as two years.

Under the conditions of the Kursk area the flight of the midge is observed from mid-May to September. The insects are most numerous in the morning and evening on calm summer days.

The eggs are elliptical in shape, of a pinkish-orange color, 0.5 mm long and 0.1 mm broad, with one end rounded and the other drawn out into a filament longer than the egg itself. The female lays one egg at a time, or, more rarely, two at a time, on the inside of the outer flower scale in the top part of the flower or, sometimes, on the outside of the same scale under cover of the internal scale of a flower situated lower down. One female is capable of laying up to 80-100 eggs.

The larva transforms into a pupa, without first making a cocoon, when it feeds on an unfertilized ovary; and the insect soon emerges. When the larva feeds on a pericarp which is forming and growing, however, its development is retarded and it spins a cocoon in which it overwinters in a condition of diapause.

Mature larvae are first found in the brome flowers at the beginning of June, the pupae from the middle of the first ten days in June. Overwintering larvae in puparia are first found in early July, or slightly earlier, in the flowers of the early-ripening upright brome.

Over a number of years mass emergence of the second generation of insects has been observed from 15 to 21 June. The second generation females lay their eggs in late-developing brome which is not flowering or in flowers which have already been shed, and sometimes in flowers where the process of pericarp formation is already taking place.

Several instances of mass emergence have been observed in the period from May to September: at the end of May and the beginning of June (first generation); at the end of the second ten days of June (second generation) and in July and early August, when a third and a fourth generation apparently emerge. At the end of the summer the midges infest the young flowers of the awnless brome aftercrop (the erect brome aftercrop yields very few generative shoots). Further observation is needed, however, in regard to the possible number of generations, the fertility and the duration of growth in different stages of the insects' life. Under laboratory conditions emergence of the midges of this species has been observed at various times of the year—in autumn, winter and spring; but in these seasons emergence is on a negligible scale. In the laboratory the life span of the females is two to three days, that of the males one to two days.

Observation shows that the midges are considerably more harmful to late-maturing varieties of brome than to others. The damage can therefore be mitigated by taking advantage of biological characteristics of the plants such as their age and by employing agrotechnical methods that hasten the formation and ripening of the fruit-bearing structures (use of fertilizers, appropriate methods of economic utilization and so forth).

The midge is described below.

Stenodiplosis bromicola Marikovskij et Agafonova, sp. n. (see Figure).

Male. Body length 2-3 mm. Eyes holoptic, occupying the greater part of the head. Antennae slightly shorter than body, 2 +12-segmented. Antennal segments binocular, gradually and becoming very slightly smaller towards apex of flagellum. Petioles and isthmuses of segments of almost equal size, not long, slightly shorter than nodal diameter. Distal nodules of flagellar segments slightly larger than proximal. 1st and 2nd flagellar segments fused, without visible line of division. Terminal segment with a nipple-like protuberance that is broad and not pronounced. Verticils of irregularly shaped arcuate filaments, short, not reaching the base of the upper antennal node. Palpi three-segmented, short, the terminal segment slightly longer and narrower than the rest.

Legs slightly longer than the body as a whole. Tarsi falciform. Empodium well developed, longer than tarsus and covered with abundant setulae. Pulvilli not developed. Wings almost as long as body. Subcostal vein passing into costal vein slightly beyond middle of anterior margin of wing. Third vein slightly curved, entering apex of wing, intersecting costal vein. Fifth vein bifid, its branches poorly developed. Halteres clavate, slightly longer than the greatest diameter of the head.

Hypopygium of moderate-size. Gonocoxites broad, short, with rounded apices, covered with very small dense setulae. Gonostyli slightly longer than half the gonocoxites, slightly curved, with

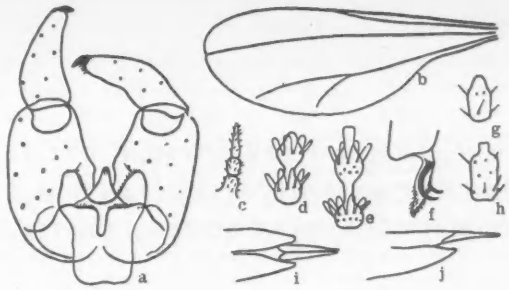

Figure. a - hypopygium; b - wing; c - palpus; d - terminal segment of male flagellum; e - 5th flagellar segment of male; f - tarsal claw; g - terminal segment of female flagellum; h - 5th flagellar segment of female; i - termination of ovipositor viewed ventrally; j - termination of ovipositor viewed laterally.

very pronounced sclerotized simple claws. Dorsal plate with a deep, narrow cleft and very blunted blades. Parameres set wide apart towards the sides, with rounded lobes varying slightly in width. Base of paramere fairly large, broad, circular, its size also varying. Ventral plate not distinct. Gonofurca conical with slightly prolate apex.

Female. Antennae considerably shorter than body and equal to the greatest length of the thorax, 2 + 12. Flagellar segments sessile, almost cylindrical, becoming slightly shorter towards apex of antenna, and with short petioles. 1st and 2nd flagellar segments as in male, fused.

Ovipositor telescopic, when extended almost as long as the body. Dorsal terminal blades of ovipositor narrow, long, apically sharpened, slightly sclerotized; ventral blades broad and membranous. Otherwise as in the male.

The species is described from 33 males and 41 females. The types are preserved in the Institute of Zoology collection (USSR Academy of Sciences), Leningrad.

University of Tomsk and All-Union Institute of Plant Protection, Leningrad

FACTORS GOVERNING THE SEASONAL DEVELOPMENT CYCLES OF THE SPINACH LEAF MINER (PEGOMYIA HYOSCIAMI PANZ) AND THE CABBAGE MAGGOT (HYLEMYIA BRASSICAE BOUCHÉ) (DIPTERA, ANTHOMYIIDAE)

SH. M. ZABIROV

The factors governing the seasonal development cycles of insects and, in particular, those which determine the onset of diapause are of great theoretical and practical interest.

Practically, the importance of studies on these questions is connected with forecasting the number of generations and the size of the overwintering population. It has been established that for most insects temperature (Kozhanchikov, 1937, 1948; Lees, 1955, et al.) and light (Danilevskiy, 1956; Dickson, 1949; Lees, 1955, et al.) play a fundamental part in governing the seasonal development cycles and the induction of diapause.

The conditions governing these phenomena in the higher flies, specifically the spinach leaf miner and the cabbage maggot, have nevertheless remained unstudied until recently. Hughes (1960) has very recently published data indicating that the diapause of the cabbage maggot depends on the duration of daylight. The purpose of the present paper is to evaluate experimentally the importance of temperature and light conditions in regulating the seasonal development of the spinach leaf miner and the cabbage maggot.

The comparative study of these species is interesting in view of the great differences between them as regards their biology.

Material and Methods

The work was done in the spring and summer of 1959 and 1960, in the entomology laboratory of the Institute of Biology (Staryy Petergof). The material was collected from infested beet and cabbage fields in the vicinity of Staryy Petergof.

Eggs, larvae and puparia were kept in the laboratory under thermostatic control at predetermined temperatures and under predetermined light periods. Temperature variations during the experiment did not exceed 1°C. A luminescent "DC" bulb was used as the light source. The light in the chambers was about 90 lx. Cut beet leaves with the leaf miner eggs on them (50) were placed in a glass cage with a capacity of 0.5 or 1.0 l. A supply of cabbage maggot adults was confined in gauze cages and fed with 0.5% sugar solution.

Groups of 30-40 freshly oviposited eggs were placed on thin (not more than 1 cm thick) slices of turnip. The larvae were reared in petri dishes. All the experiments were repeated two or three times. In each series of tests 30-60 individuals, in the puparium stage, were used. The work was directed by A. S. Danilevskiy.

Results

Influence of temperature and light on growth and induction of diapause in the spinach leaf miner and the cabbage maggot. The experiment showed that eggs, larvae and puparia of the spinach leaf miner and the cabbage maggot could develop at temperatures within the range of 11 to 30°C. At excessively high temperatures, however, (27-30°) the development of the eggs was retarded by 2-4 days and the mortality rate reached 35% in the case of the spinach leaf miner and 5% in that of the cabbage maggot.

The optimum temperature range for spinach leaf miner larvae was more limited. Only within the range 18-21° did growth proceed uniformly, without mortality. The mortality rate increased both above and below these temperatures, reaching 50% at 30° and 10% at 10°.

The cabbage maggot larvae were more resistant to temperature influences, developing without mortality at temperatures within the range 15-25°. The puparia both of the cabbage maggot and of the spinach leaf miner showed a more complex reaction to temperature; some developed without retardation and uniformly, the variation in the duration of growth periods in the case of such active puparia showing a general, almost hyperbolic dependence on temperature.

Table 1 gives the relevant data on the duration of puparial growth under laboratory conditions at various temperatures; Table 2 shows the corresponding data for first generation individuals collected in nature.

In both cases the duration of growth shows a complex dependence on temperature. While some individuals develop actively, a number of puparia remain for a long time in an inhibited condition. The number of such growth-retarded puparia increases at extreme temperatures, particularly at high temperatures, as Kozhanchikov (1939) has noted.

Figures 1 and 2 show the percentages of non-developing puparia of both species in the first and second generations. The tests were made on fresh puparia collected in nature. In both species the second generation puparia failed to yield adult insects owing to the beginning of diapause.

The incomplete emergence of flies from the first generation puparia, however, was due not to diapause but to other phenomena (infestation by parasites, inhibition resulting from low and high temperatures, and so forth). As can be seen from Figs. 1 and 2, the temperature optimum was lower for cabbage maggot puparia than for the spinach leaf miner.

To determine the influence of temperature and light on the induction of diapause, eggs and larvae of the two species were reared under conditions of continuous lighting and under short-day conditions (12 hours light in 24) at various temperatures. The puparia were kept under similar conditions. Table 3 shows the results obtained. In general, the proportion of diapausing puparia increased with reduction of temperature with both long and short days. The figures in Table 3 show that the light factor exerts a very strong influence on the induction of diapause. In the case of the spinach leaf miner, for example, diapause did not occur at 21° under long-day conditions, whereas under short-day conditions 80% of the puparia went into diapause.

At 18° a small proportion of the cabbage maggots (about 9% of the puparia) diapaused under long-day conditions, against 96.2% under short-day conditions. In both species, therefore, a clearly expressed photoperiodic reaction governs the beginning of diapause, and as regards this reaction both must be classified as long-day types. Temperature also affects the diapause: a gradual increase in the number of diapausing individuals is observed as the temperature is lowered and this increase is especially pronounced under short-day conditions. When the larvae develop under low-temperature conditions (12°) diapause sets in independently of the length of day. To establish which growth stages were most susceptible to light conditions, we experimented with varying the light factor while the leaf miner and the cabbage maggot were developing at a

Table 1

Influences of temperature on duration of growth of the spinach leaf miner and the cabbage maggot (in days)

	Growth stage	11.8°	14.8°	18.7°	20.5°	25.4°	27.5°	30°
Spinach leaf miner	Egg	5(4—5.6)	4.1(3.7—5)	3.8(3.4—4.5)	3.5(3—4.1)	3.1(2.1—3.6)	3(2—4)	3(2—4)
	Larva	17(16—20)	14.8(14—15)	10.8(10—12)	9.1(8.7—10)	7.8(7—8.9)	7.3(7—8)	7.1(7—8)
	Puparium	25(24—28)	20(19—22)	16.5(16—18)	13.9(13—15)	12(10—13)	11.8(10—12)	11.3(10—12)
Cabbage maggot	Egg	6(5.8—7.5)	5.8(4—6)	4.2(3.9—5)	3.6(3—4.1)	3.1(3—4)	3.8(2.7—4)	—
	Larva	32(28—35)	20.8(19—22)	18(17.7—19)	15.3(14—17)	13.9(12—15)	12.6(12—13)	—
	Puparium	35.8(31—44)	24.9(22—27)	20.4(19—23)	17.9(16—20)	15(14—15.8)	13.1(12—14)	—

Table 2

Influence of temperature on duration of puparium growth (in days)

Temperature	Spinach leaf miner	Cabbage maggot
10°	48.9 (40—55)	49.6 (38—52)
12°	38 (30—45)	34.5 (30—38)
15°	25.5 (23—27)	27 (18—30)
18°	18.9 (17—20)	20 (16—26)
21°	15.1 (15—17)	16.9 (16—18)
25°	11.6 (10—12)	14.9 (11—18)
27°	10.5 (10—11)	12 12)

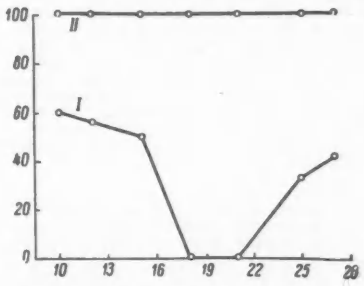

Fig. 1 - Influence of temperature on diapause induction in Pegomyia hyosciami Panz. puparia. Abscissa - temperature; ordinate - percentage of diapausing puparia. I - first generation puparia; II - second generation puparia.

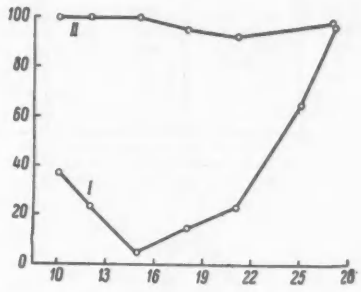

Fig. 2 - Influence of temperature on diapause induction in Hylemyia brassicae Bouché puparia. Key as for Fig. 1.

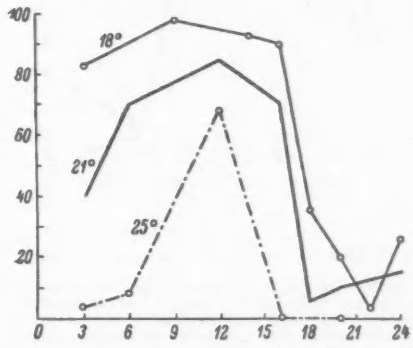

Fig. 3 - Photoperiodic reaction in Pegomyia hyosciami Panz. at different temperatures. Abscissa - length of days, in hours; ordinate - percentage of diapausing puparia.

temperature of 20°. The larvae reared under long-day conditions formed non-diapausing puparia, those reared with 12 hours light per day formed diapausing puparia. These results were independent of the length of day during the egg stage. It follows that the larval stage is the one most sensitive to the photoperiodic reaction in these two species.

Photoperiodic Reaction of the Spinach Leaf Miner and Cabbage Maggot

In order to establish the precise relationship between diapause and the photoperiodic and temperature conditions, the eggs and larvae were kept under different conditions as regards length of day and at different constant temperatures (18, 20, 23 and 25°).

Figure 3 shows the results obtained in the case of spinach leaf miner, figure 4 those for the cabbage maggot. At a temperature of 25° with 16-20 hours light per day, emergence in the case of Pegomyia hyosciami Panz. was complete; that is, none of the puparia diapaused. With 12 hours of light, 70 per cent of the puparia diapaused but with further reduction of the light period to 9 and 3 hours the proportion of diapausing puparia again fell (to 4% with 3 hours light per day).

The tests at 21° gave the following results. The lowest proportion of diapausing puparia was observed at 18-24 hours light per day. With a shorter day, the number of diapausing individuals sharply increased, reaching 85% at 12 hours light per day. The critical day length, inducing diapause in 50% of the individuals, lay between 16 and 17 hours, or precisely, 16 hours 30 minutes. A similar distinct photoperiodic reaction occurred at 18°, when the critical length of day was 17 hours 30 minutes.

As can be seen from Fig. 3, the critical length of day for the photoperiodic reaction is not constant. A 7° reduction in temperature (from 25 to 18°) raises it from 13 hours to 17 hours 30 minutes, or by four and a half hours. Such a change in the critical length of day as a function of temperature conditions can lead to a change in the periods of diapause

Table 3

Influence of temperature on diapause induction with different lengths of day

Species	Temperature	Long day (24 hours light)			Short day (12 hours light)		
		Number of puparia	Number of developed puparia	Percentage of diapausing puparia	Number of puparia	Number of developed puparia	Percentage of diapausing puparia
Spinach leaf miner	25°	—	—	—	30	10	66
	21°	30	30	0	30	6	80
	18°	50	40	20	50	5	90
	15°	46	30	34.9	41	0	100
	12°	70	0	100	60	0	100
Cabbage maggot	25°	30	18	40	30	3	90
	21°	25	19	24	25	2	92
	18°	33	30	9	27	1	96.2
	15°	60	35	41.6	48	1	98
	12°	35	0	100	23	0	100

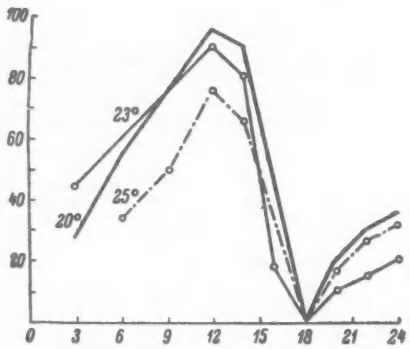

Fig. 4 - Photoperiodic reaction in Hylemyia brassicae Bouché. Key as for Fig. 3.

induction in nature.

The curves for the photoperiodic reaction in the cabbage maggot at temperatures of 20, 23 and 25° are very similar to one another. Total absence of diapause occurred only with 18 hours lighting; the highest number of diapausing puparia was observed with 12 hours lighting per day. Continuing the illumination for 18 hours caused the proportion of diapausing puparia to rise. This effect was very marked in the cabbage maggot. A tendency for the number of diapausing puparia to increase when lighting was continuous could be observed in the spinach leaf miner, but much less strongly than in the cabbage maggot.

When the length of day was less than 12 hours the proportion of cabbage maggot puparia diapausing at temperatures from 25 to 20° fell sharply. With this insect, unlike the spinach leaf miner, the photoperiodic reaction threshold hardly varies at all with temperature, the critical length of day remaining about 15 and one half hours under all conditions.

CONCLUSIONS

The experiments show that in the spinach leaf miner and the cabbage maggot diapause induction is governed both by light and by temperature conditions during the growth period of the larva. The effect of light is strongest at moderately high temperatures (18-25°). Both factors undoubtedly play a part in regulating the seasonal development of both species under natural conditions.

Diapausing puparia of the spinach leaf miner and the cabbage maggot, up to a proportion of 20-25%, are found as early as July in the case of the first generation. At the end of July the number increases to 40%. Finally, 100% diapausing occurs in both species at the beginning of September. It is interesting that the pattern of increase as regards diapausing should be so similar in both species.

The onset of diapause in the first generation at the beginning of July, when the day is very long (18 hours daylight, not counting twilight) is most probably explained by the low temperature during the period of larval growth. In 1959 the air temperature during this period remained at or just under 16°, against 18° soil temperature at a depth of 5-10 cm. According to the experimental figures the number of diapausing spinach leaf miners varied between 20 and 30% under long-day conditions at temperatures between 15 and 18°, as compared with 10 to 40% in the case of the cabbage maggot. These figures coincide with those obtained under natural conditions.

The increase up to nearly 100% at the end of August and the beginning of September cannot be explained only as the influence of temperature, since the temperature was even higher during the larval growth period than during the development of the first generation. In August 1959, for example, the temperature of the air remained at 18° and the soil temperature at a depth of 10 cm at or just under 20°. There are grounds, therefore, for believing that the sharp increase in the number of diapausing larvae towards autumn is governed by the shorter length of day. In Leningrad the length of day in August varied from 16 hours 50 minutes to 14 hours 12 minutes. It can be seen from Figs. 3 and 4 that such conditions will induce diapause in most of the puparia. In the case of the spinach leaf miner, whose larvae develop in mines on the leaves and are exposed to light, the relationship between growth and diapause on the one hand and length of day on the other is readily understandable; but it is harder to account for this relationship in the case of the cabbage maggot, which lives in the soil.

Hughes (1960), having observed the induction of diapause in the cabbage maggot under greenhouse conditions at constant temperature throughout the year, also reached the conclusion that for this species diapause depended on the length of day. He suggests, however, that the larvae cannot receive photoperiodic stimuli directly, since they live in the soil, and that root-feeding insects receive such stimulus through changes in the chemical composition of the plant caused by changes in the length of day. Investigations on other species (Laspeyresia molesta Busck [Dickson, 1949], Diataraxia oleracea L. [Way and Hopkins, 1950], Metatetranychus ulmi C. R. Koch [Lees, 1953] and others) have shown that photoperiodic stimuli acting on the plant do not influence the response of the insect.

CONCLUSIONS

1. Diapause in Pegomyia Myosciami Panz. and Hylemyia brassicae Bouché is governed by seasonal variations of temperature and length of day.

2. For Pegomyia hyosciami the critical length of day as regards photoperiodic reaction is 13 hours at 25° and 17 hours 30 minutes at 18°; for Hylemyia brassicae the corresponding periods are 15 and 16 hours respectively.

3. Both species are in the long-day class as regards the general character of the photoperiodic reaction.

4. A fall in temperature during the growth period leads to an increase in the critical length of day. This tendency is pronounced in Pegomyia hyosciami and weak in Hylemyia brassicae.

5. In Hylemyia brassicae larvae the photoperiodic reaction is a response to direct light stimuli, not to stimuli received through the food plant.

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EFFECT OF DIFFERENT DOSES OF DDT ON THE DEVELOPMENT OF THE INTOXICATION PROCESS IN BLOWFLIES

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Elucidation of the quantitative pattern of insecticidal action on insects is a practical necessity, so that the required poison dosage may be determined, and is at the same time a help in understanding the mechanism of insecticidal action. For practical purposes, the mortality rate is usually established either by varying the dose over a given period or by testing the effect of a constant dosage over a number of different periods. The shape of the dose-mortality or time-mortality curves so obtained is governed by the statistical distribution of individuals in the given group on insects in terms of their poison-sensitivity (Bliss, 1935; Taterfield, 1939). In examining the mechanism by which a poison operates on an animal organism, one finds that the rate of development of intoxication and the relationship between this rate and the dosage are of major interest.

Quantitative investigations of the effect of DDT on insects are concerned mainly with determining the LD_{50}, and only a few papers indicate the survival time associated with different doses (Wiesman, 1943; Pradhan, 1949; Mer and Davidovici, 1950). Only Yeager and Munson (1949) have devoted a paper specifically to the rate of DDT intoxication in relation to dosage. As a result of experiments, the authors conclude that throughout the whole range of lethal doses, the duration of survival after administration of oil solutions of DDT to the cuticula is given by the hyperbolic equation

$$(C-C_0)\,(t-a) = k,$$

where C is the poison concentration, C_0 is the highest poison concentration giving a survival time near that of the control, t is the insect's life-span, and a and k are constants.

The purpose of the work described in this paper was partly to determine the rate at which concentration DDT operates when used as a contact poison in crystalline form. This method of poisoning is not only the more usual in the case of many insects but also has the advantage of eliminating the influence of the solvent on the rate of the toxicity process.

The tests were performed with 15 logarithmically increasing doses of DDT, the peak dosage being more than a million times larger than the minimum dose. The test insects were adult spring blowflies, Protophormia terraenovae R. -D., reared in the laboratory and kept on a carbohydrate diet after metamorphosis. For poisoning, the flies were placed, 20-45 at a time, on discs of photographic film which had earlier been treated with an alcohol solution of commercial DDT so that by the time the experiment began the alcohol had evaporated and the film was covered with a layer of small DDT crystals. The discs, with the flies on them, were then covered with Petri dishes, the inside surfaces of which had also been first treated with the poison. In all the tests contact with the poisoned surface lasted for ten minutes, after which the insects were transferred to clean Koch dishes. Control flies, which had not been exposed to DDT, were also captured from breeding sites and placed in Koch dishes. As the poisoned insects were no longer feeding, both the experimental and the control groups were kept in the Koch dishes without water or food. To determine the rate of the DDT intoxication the lifetime of the individual flies from the moment of contact with the poison until the development of total paralysis was taken into account. The onset of total paralysis was judged from the absence of motor response to mechanical stimulation. The average survival time of the flies was calculated for each concentration on the basis of the figures obtained.

Altogether, 1204 flies were used in three series of tests. First a pilot series was performed, with a small number of young flies (2nd-5th day after emergence). The tests were then repeated on a large number of flies 7 to 11 days old. The results of both series were plotted on a logarithmic-scale graph so that a wide range of DDT doses could be covered (Fig. 1, a). As the graph shows, the dose-survival curves are essentially of the same type in both series;[1] in both, the lifetime of the experimental insects after contact with small doses of the poison was the same as or slightly longer than that of the control flies. The lethal effect of DDT in both series appeared only when doses of 0.01-0.02 g/m^2 were reached; a 10-minute contact with the poisoned surface then brought the survival time down to between a third and a fifth that of the control flies. Once these threshold doses were reached, further increase in the amount of DDT on the surface had very little effect on the survival time. Even the highest dose killed the flies only many hours after contact.

In the third series the rate of development of intoxication in the threshold-dose region was studied in greater detail and the tests were performed separately on males and females. The results, given in Table 1, show that the sexes differ in DDT-sensitivity only in regard to threshold doses, and are in accordance with the findings of a number of authors (David, 1946; Ludvik, 1953; Kerr, 1954; Badanov, 1955 and others), namely, that males are more DDT-sensitive than females. In our experiments the threshold dose for males was also found to move in the direction of the lower doses (0.0065 g/m^2), against 0.01 g/m^2 for the females. Beyond the male threshold dose the survival time for males and females proved to be very much the same (average life after contact with an 0.01 g/m^2 dose — 2362 minutes for males, 2621 minutes for females).

Taken together, the experiments showed that DDT doses can be divided into three groups, according to their effect on the survival time of blowflies: subthreshold, threshold and superthreshold. All three of these dosage brackets can be distinguished on the survival-dosage curve when this is plotted on logarithmic scale (Fig. 1, a). Within each, the character of the survival time to dose relationship remains constant, but varies from one bracket to the next. The curve can be seen to consist of three rectilinear sections with breaks at the transition from one dose region to the next.

We must accordingly divide the lethal DDT doses into threshold and superthreshold brackets, each with its own relationship between the survival time of the blowflies and the DDT dosage. This conclusion differs from that of Yeager and Munson, who inferred that there is a constant relationship, expressed by the hyperbolic equation, between the lifetime of houseflies exposed to any lethal dose of DDT and the size of the dose. In order to find out whether there is a common pattern of response to various doses of DDT by different species, or whether each species reacts in its own way to this poison, we analyzed both the Yeager and Munson data on houseflies and Pradhan's data (Pradhan, 1949) on Tribolium castaneum, plotting these authors' results on a logarithmic graph in the same way as our own figures. Graphical analysis of this kind makes it possible not only to compare the character of the relationship obtained for different species but also to see at a glance the limits within which the hyperbolic equation applies, since

[1] The different levels of the first and second series curves are due to the different ages of the flies in the two series of tests.

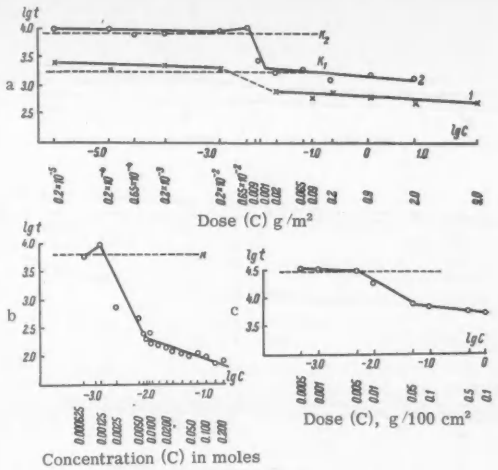

Fig. 1 - Survival time of insects after poisoning with various doses of DDT. Ordinate - log. DDT dose (a,b: per unit contact surface; c: in molarity of solution administered to cuticula; abscissa - log. survival time, in minutes. The figures under the graphs indicate absolute values of all doses used in the experiments. Horizontal broken lines k,k_1,k_2 indicate life span of control insects. Graph a - our experiments with Protophormia terrae-novae R.-D. (1 - first series; 2 - second series). Graph b - Yeager-Munson experiments with Musca domestica. Graph c - Pradhan's experiments with Tribolium castaneum Hbst.

Table 1

Survival times of male and female blowflies (Protophoria terrae-novae R. -D.) ster 10-min. contact with DDT-treated surface

DDT dose on surface	Sex	Number of flies in test	Mean survival time (min.)
Control.....	♂	25	6755
	♀	24	7154
0.004 g/m². . .	♂	32	7250
	♀	25	7866
0.0065 » . . .		35	2512
	♀	18	6833
0.01 » . . .	♂	37	2362
	♀	24	2621
0.02 »	♀	21	1622

this equation gives a straight-line curve on a logarithmic graph. On examining the graph constructed from the Yeager-Munson figures (Fig. 1, b), one realizes that it is only for the higher dosages that the points in the curve lie on one straight line, and that the points obtained for the low lethal concentrations lie above the continuation of this line. In other words, the hyperbolic equation holds good only for superthreshold-doses, whether houseflies or blowflies are in question; in the threshold-dosage region, the flies die more slowly than they should according to the equation.[2] The concentration-time mortality curves both for the housefly (Fig. 1, b) and for Tribolium castaneum (Fig. 1, c) correspond in shape to our experimental curves for blowflies. In the latter too we can distinguish three dosage regions, a subthreshol, threshold and superthreshold. The quantitative relationship between survival time and DDT dosage may therefore be taken as a common feature in the reaction of insects to DDT poisoning.

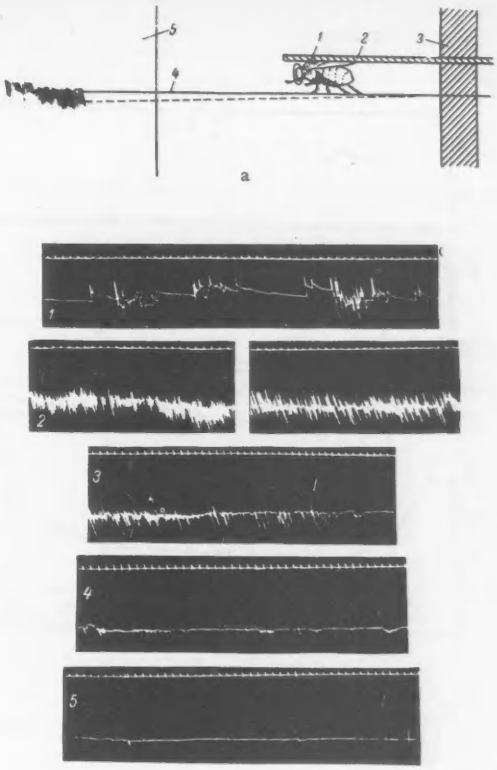

Fig. 2 - Tarsal movements of DDT-poisoned flies at various stages of poisoning. a - Apparatus for kymographic tracing of movements: fly (1) attached by wings to strip of cardboard (2) fastened to support (3); tarsi are touching an elastic strip of paper (4) which reproduces vibrations on kymograph film (5). b - Trace of movements (reading from left to right, vibrations of recording pen due to vibration by the fly's tarsi; top line - time mark, 30-sec intervals). 1 - before poisoning; 2 - at "convulsion" stage from 15th to 28th and from 105th to 114th min.; 3 - beginning of "tremor" stage, 150th to 178th min.; 4 - end of "tremor" stage, 202nd to 224th min.; 5 - when only the reflex response remains, 247th-271st min.

In the second series of tests, in addition to discovering the mortality time, we tried to obtain a fuller picture of the flies' reaction to contact with various doses of DDT by taking into account their condition at different times after poisoning had started. To this end we divided the poisoning process into a number of stages, as was done by Buck and Keister (1949). In addition to the usual observations of the insects' behavior, we identified the stages by using a kymographic

[2]The error in the Yeager and Munson conclusion is due to their not having allowed for the 36-66 per cent deviations from a hyperbolic curve which are observed in the case of very low lethal doses; they treated these as merely experimental errors, even though the experimental error with higher doses (that is, the deviation of the experimental values from the values theoretically calculated from the hyberbolic equation) does not exceed 6-15 per cent.

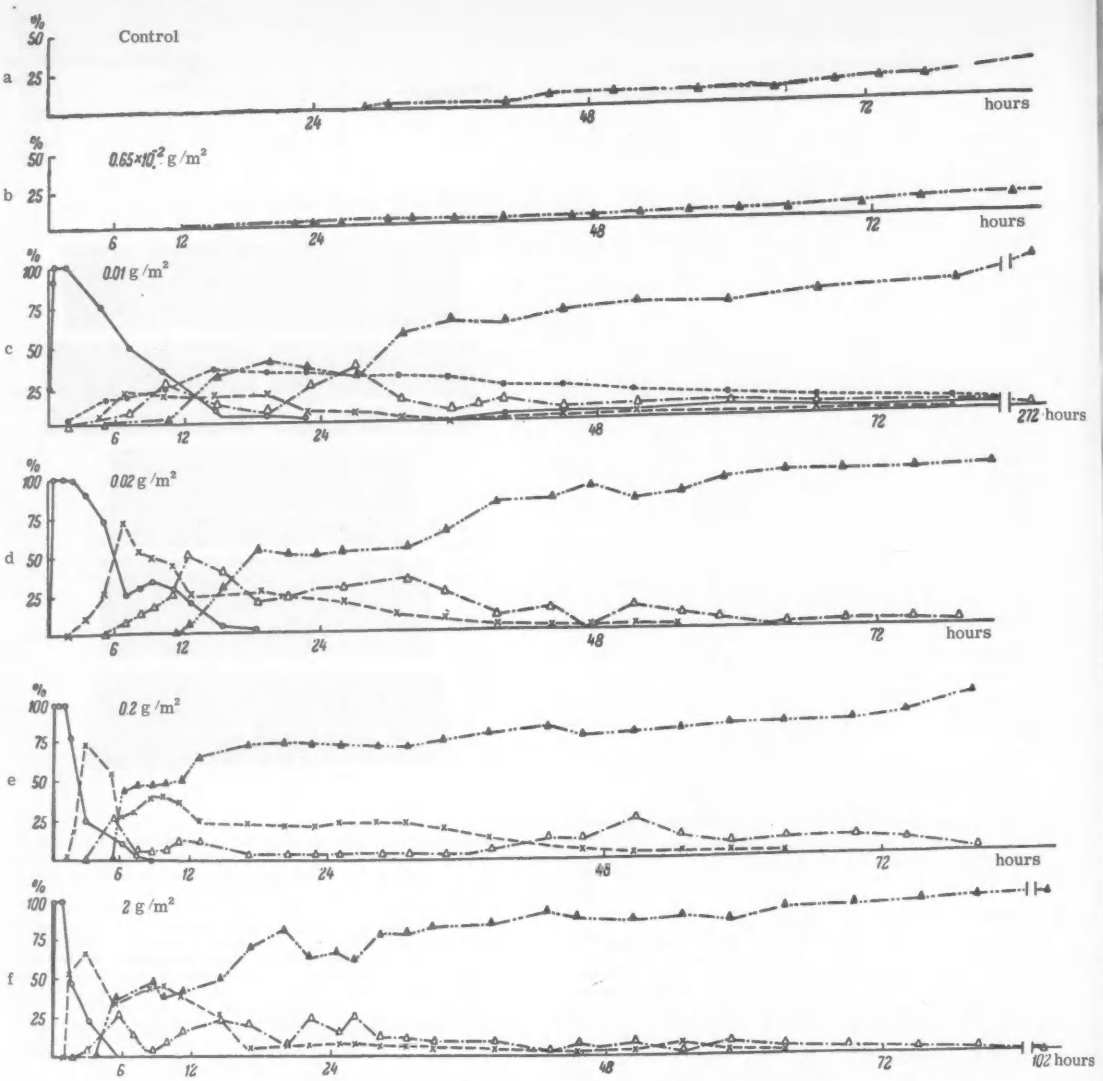

Fig. 3 - Change in condition of flies with time, after ten minutes contact with a surface treated with: a) alcohol solution without DDT (control series), b) 0.65 x 10^{-2} g/m² DDT, c) 0.01 g/m² DDT, d) 0.02 g/m² DDT, e) 0.2 g/m² DDT, f) 2.0 g/m² DDT. Abscissa - time, in hours; ordinate - number of flies as percentage of total, at various stages of poisoning. Key to curves: o-o-o - "convulsion"; x-x-x - "tremor"; Δ-Δ-Δ - reflex only; ▲-▲-▲ - general paralysis; ●-●-● - recovery.

track of the poisoned flies' movement (Fig. 2). Five stages were distinguished in regard to motor reaction: 1) general motor excitement and loss of coordination, 2) "convulsions", 3) "tremor", 4) "maintenance of the reflex response in the absence of spontaneous movements", 5) "general paralysis". The number of flies in the second, third and subsequent stages of poisoning was counted from the moment each group of insects ceased to be in contact with a poisoned surface carrying a given dose of DDT.[3] In each series of tests this number was expressed as a percentage of the total number of flies subjected to the dose in question and the results were then plotted on a common graph so as to show the rate of change in the flies' condition after poisoning.

All the dosages we investigated can be divided as regards the reaction of the flies to contact with DDT into the same three groups as were distinguished in regard to survival time. The first group consists of subthreshold doses (0.02 x 10^{-5} - 0.65 x 10^{-2} g/m²), which produce none of the characteristic symptoms of DDT poisoning. Figure 3 shows the results of these tests. By way of example, typical of the action of all subthreshold doses, Fig. 3, b shows the effect of 0.65 x 10^{-4} g/m² of DDT on the flies. The similarity between the results of this test and those of the observations on the control group is striking (Fig. 3, a). In both cases some insects are dying at the beginning of the second day, although very few (one to three); the number of dying flies gradually rises,

[3]The first stage did not last long and not only started, but with most dosages also terminated within the first ten minutes, while the flies were still in contact with the poisoned surface; no direct count, therefore, was taken at this stage.

Table 2

Maximum increase in survival time of insects subjected to subthreshold dosage in various ways

Insect	Method of administration	Threshold dose	Subthreshold dose giving maximum prolongation of life	Mean duration of life t_1 with the given manner of administration	Mean duration of life t_2 of control insects	$\Delta t = t_1 - t_2$	Source
Periplaneta americana (L.)	Injection of NaCN solution						
	series A	0.07140—0.06112 M	0.00510 M	53568	44208	9360	Munson & Yeager, 1947.
	series B	0.08160 M	0.04080 M	58608	45792	12816	
	series C	0.08160—0.00714 M	0.00510 M	53568	45000	8568	
"	Injection of KCN solution	0.03840 M	0.00768 M	50832	44352	6480	"
"	Injection of sodium metarsenate solution	0.150—0.100 M	0.01923 M	49824	45720	4104	Yeager & Munson, 1945 a.
Nasca domestica L.	Administration of oil solution of DDT to cuticula	0.0020 M	0.00125 M	8560	7257	1703	Yeager & Munson, 1949.
Tribolium castaneum Hbst.	Contact with surface treated with 0.5 per cent BHC in benzine	—	0.5%	37584	35280	2304	Pradhan, 1949.
"	Contact with surface treated with DDT solution in benzine	0.01—0.005 g/100 cm²	0.0005 g/100 cm²	36432	35280	1152	"
Protophormia terraenovae R.-D.	Contact with DDT-treated surface:						
	1 series	(0.02) g/m²	0.2×10^{-3} g/m²	2716	1828	886	Our data.
	2 series	0.01 g/m²	0.0065 g/m²	10680	8636	1944	
	3 series, ♂	0.0065 g/m²	0.004 g/m²	7250	6755	495	
	4 series, ♀	0.01 g/m²	0.004 g/m²	7866	7154	712	

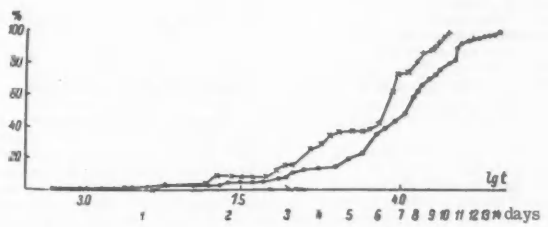

Fig. 4 - Comparison of number of dead flies after various periods. x-x-x - without DDT contact (control); o-o-o - after contact with subthreshold dose of DDT 90.65 x 10^{-2} g/m²).

until on the 6th day mortality is 50 per cent and on the 11th day, 100 per cent. It is to be noted that with subthreshold doses the percentage of dead insects in the test group does not exceed that in the control group. In both groups, the flies die without any signs of DDT poisoning.

By way of contrast, signs of poisoning appear within the first few minutes of contact with the larger doses (0.2 x 10^{-2} g/m² - 2.0 g/m²): the coordination of movements is disturbed, convulsions develop and subsequently turn into slight twitchings of the extremities — tremor. The intensity of this tremor gradually diminishes and it becomes spasmodic, until finally the flies are lying in a state of paralysis most of the time and the twitchings appear only in response to mechanical stimulation (Fig. 2, b). All the stages of poisoning thus develop in turn, with the lethal doses, before the insect dies (Fig. 3, c-f). As can be seen from the graph, these stages set in at different periods in different insects, since particular flies vary in DDT-sensitivity: hence, the simultaneous presence of flies in the second, third, fourth and even fifth stages of poisoning (see, for example, Fig. 3, e, which shows the position 6 hours after poisoning). It is nevertheless possible to tell which stage of poisoning is the prevalent one at any given moment. As with the mortality rate, comparison of the results of various lethal doses shows a group of superthreshold doses (0.065 g/m², 0.2 g/m² and 2 g/m² of DDT), which cause a roughly uniform change in the flies' condition (Fig. 3, e-f), indicating that a ceiling of effectiveness has been reached. With the weaker threshold doses (0.01-0.02 g/m²) the insecticide takes effect rather more slowly. The effect of the very lowest threshold dose (0.01 g/m²) is particularly interesting. After contact with a surface containing this amount of the poison the fly, as usual, develops convulsions. This happens later than it does when the dosage is higher, but the convulsion stage nevertheless lasted for an hour in 100 per cent of the test flies (Fig. 3, c). In most cases the toxic process continues and the flies die; in some, however, not only does the poisoning fail to progress, but all signs of it disappear and the flies recover. Only five hours after poisoning with 0.01 g/m² of DDT normal flies, which had recovered from the poisoning, were observed. The number of such flies gradually increased and after 15 hours totaled one third of all the flies used in the test.

As we attached great importance to the recovery observed we followed the behavior of the poisoned flies in the third series of tests as well. These not only confirmed that recovery occurred in both males and females but also showed that it occurred with all doses within the threshold bracket.

We can therefore assert that after poisoning with minimally toxic, threshold doses of DDT the organism of the blowflies is capable of overcoming the toxic effect of

this insecticide.

Here it is important to emphasize first, that recovery was observed only in cases where poisoning had not advanced beyond the convulsion stage and secondly, that it was not conditioned by any external influence such as a rise in temperature.

The disappearance of DDT-poisoning symptoms and the recovery of insects have already been described in regard to certain insects (Savchenko, 1946; Witt, 1947; Derbeneva-Ukhova and Morozova, 1950; Derbeneva-Ukhova et al., 1952; Lil'p, 1952). According to Barber and Schmitt (1949) and Bruce and Decker (1950) recovery can occur in DDT-resistant houseflies even at deeper stages of poisoning. These authors connect the rapid recovery of the insects with dehydrochloration processes.

In our opinion the toxic effect of DDT is overcome not so much by direct breakdown of the poison (dehydrochloration) as by other processes, which may block the action of the DDT or offset the disorders it causes. Our grounds for this conclusion are that in most cases the recovery is not final; after a few hours the flies again develop symptoms of DDT-poisoning and die in the manner characteristically associated with this poison. It can be seen from Fig. 3, c, for example, that after an interruption the insects again appear at the convulsion stage, and then at the tremor stage.

It is well known that insects' resistance to DDT is greatly influenced by their diet and the presence of fat reserves in the organism (McGowan and Gersdorff, 1945; Shmeleva, 1955; Yaguzhinskaya, 1953; Mer and Furmaska, 1953; Barbarin, 1956; Korovina, 1958). If the lipoid content in the organism is greatly reduced, through hunger or breakdown by lipases, the flies' resistance to DDT is drastically lowered (Wiesmann, 1957). Since in our experiments the insects were deprived of food it may be thought that the secondary development of poisoning in them was due simply to hunger, utilization of their available fat reserves leading to the liberation of poison absorbed by the fatty tissue.

Despite these unfavorable conditions, however, the flies which recovered stayed normal for 1-4 days, and isolated individuals for even nine days. The life span of these individuals was commensurate with that of the control insects. This gives grounds for thinking that under natural conditions, where food is available, such insects could recover completely. This in turn raises the important question of whether flies which have recovered from DDT poisoning play a part in the production of DDT-resistant strains. This question, however, cannot be settled on the basis of our material and calls for special genetics research.

As we indicated above, the insects subjected to subthreshold doses of DDT lived longer than those in the control group. This effect was observed in all three series of tests. In the second series, for example, individual flies lived particularly long (up to 14-15 days, against 10 days in the case of the longest-lived control flies; Fig. 4) after administration of the extreme atoxic dose (0.065×10^{-2} g/m^2 of DDT). It is significant that the longer survival time associated with the effect of subthreshold doses is observed not only with blowflies but also with other insects. Moreover, the figures given by a number of authors show that this effect is produced by weak doses of cyanide, sodium metarsenate and even the composition used as organic solvent (Table 2).

Since in all these experiments the control insects suffered certain unfavorable influences (as did the experimental insects, which were starved or, if not, were injected with physiological solution as in the Yeager-Munson experiments), we can assume that the prolongation of life observed was due to a non-specific heightening of resistance connected with the subthreshold action of a great variety of substances. At this level of thinking, the discovery that the lifetime of experimental flies subjected to subthreshold doses of DDT was prolonged in our experiments should be associated with the more pronounced, identical process of counteraction which, as we saw, occurs under the effect of threshold doses of insecticide. On the other hand, it is possible that threshold doses of DDT simply lower the rate of metabolism to some extent, giving the insect better survival capacity under starvation conditions. Kerr's experiments (1954) with fruit flies, showing increased resistance to carbon dioxide after weak doses of DDT, can be taken as corroboration either of the theory that there is a non-specific heightening of resistance following the effect of subthreshold doses of DDT or of the hypothesis of lowered metabolism.

If we compare the rate at which intoxication develops in insects subjected to various doses of DDT with the corresponding rate for a number of other, inorganic, insecticides [metarsenate and cyanide compounds (Yeager and Munson, 1945a; Munson and Yeager, 1945, 1947)] we find that with DDT, unlike inorganic poisons, a fairly considerable time must elapse between the moment of poisoning and the death of the insect. This time lapse is a matter of hours in the case of very rapidly dying Diptera, but of days for most other insects. It is important to emphasize that DDT requires a prolonged period of this kind, before it exerts its lethal effect, not only when it is used in threshold doses but even when maximum doses, more than a hundred times larger than the threshold dosage, are used.

Although the lethal outcome of DDT poisoning is slow to develop, the symptoms set in very early. Even with the lowest lethal dose, convulsions occur in all flies one hour after poisoning and with larger doses the convulsion stage is reached in 10-15 minutes. In the Yeager-Munson experiments (1949) the flies fell on their backs a few minutes after poisoning and with superthreshold doses the logarithm of the knockdown time was a linear function of the logarithm of the dose. The rapid onset of convulsions is due to the excitation of a pathological pulsation in the peripheral elements of the nervous system (Yeager and Munson, 1945b; Tobias and Kollros, 1946; Dresden, 1948; Röder and Weiant, 1948; Fritsch and Krupp, 1952; Weiant, 1955, et al). According to Röder and Weiant (1951) such pulsation is observed only 1-30 minutes after injection with DDT emulsion; the higher the DDT concentration, the sooner it sets in. In this case too, the logarithm of the pulsation onset-rate is directly proportional to that of the dose administered.

The considerable time lapse between the initial and final manifestations of the effect of DDT bears out the opinion that a pathological pulsation excited in the afferent part of the nervous system cannot be the cause of death. The fact that intoxication develops slowly is much more line with ideas that DDT acts primarily on the tissual metabolism. Such views were first advanced by Kozhanchikov (1947) in connection with the fact that insect sensitivity to DDT depends on the rate of respiration and have since been repeatedly confirmed, sometimes by biochemical research (Sacktor, 1950; Johnston, 1951; Anderson et al, 1954; Morrison and Brown, 1954; Ludwig et al, 1955 and others).

According to this point of view, the action of DDT is similar to that of cyanide on the ferriferous respiratory enzymes of the cell.

Comparison of the rates of DDT and cyanide action reveals that, while the effect of subthreshold and threshold doses is similar, a substantial difference occurs when the poison dose is increased beyond the threshold dose: with DDT, such increase of dosage has no material effect on the intoxication rate, which remains as low as before, whereas in the case of cyanide compounds of potassium or sodium the rate tends to increase with the dosage injected. With high dosages, paralysis sets in after only a few minutes; this is due to the capacity of cyanides to exert an initial narcotic effect. In our opinion these differences between the effect of DDT and that of cyanides are not due to the fact that the poisons act at a different point on the enzymatic cell systems, but rather to differences in the conditions of penetration and distribution of these poisons in the organism. Here it is most important to note that in vitro experiments have also revealed a very slow development of respiratory-enzyme inhibition due to DDT (Morrison and Brown, 1954; Ludwig et al. 1955).

CONCLUSIONS

1. Study of the reactions of spring blowflies (Protophormis terrae-novae R. -D.) to poisoning with various doses of DDT (10-minute contact with a surface treated at the rate of 0.2×10^{-5} to 9.0 g/m^2) showed that survival time has a complex relationship to dosage. Three dosage brackets can be distinguished, the relationship between dosage and survival time differing in each case: subthreshold, threshold and superthreshold.

2. In the case of superthreshold doses of DDT the survival time — dosage relationship is governed by the Yeager-Munson hyberbolic equation (1949), whereas with the weaker, but still toxic doses, the insects die a good deal later than they should according to this equation. Lastly, the effect of subthreshold doses of DDT can prolong the life of experimental insects as compared with the control insects.

3. As is shown by the Yeager-Munson (1949) and Pradhan (1949) experimental data, there is a similar dependence of mortality time on dosage connected with the effect of DDT on other insects (houseflies and Tribolium castaneum), indicating that such a relationship is characteristic of the reaction of various insects to a wide range of doses of DDT.

4. It was found that many flies were capable of overcoming the toxic effect of threshold doses of DDT. In such flies the intoxication process not only fails to continue after some time, but actually diminishes: the convulsions excited immediately after contact with a poisoned surface disappear after a few hours and the insects recover. This indicates that to produce a reliable toxic effect and obviate adaptation to this poison, superthreshold doses of DDT must be used.

5. The information obtained in regard to the rate at which DDT intoxication develops permits the expression of certain views on the mechanism of this poison's operation.

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CALLOSITY-LIKE GALLS ON POPULUS PRUINOSA

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In the course of forest pathology surveys in the tugay forests of the Amu-Dar'ya and Syr-Dar'ya in 1954-1957 we came across large-scale development of a peculiar callosity-like gall caused by the psyllid Egeirotrioza sp. (Fig. 1).

This insect infests mainly the blue turanga, Populus pruinosa Schrenk, and, to a lesser extent, P. ariana Dobe, both in natural forests and in urban plantations. In the town of Urgencha (Khorezmskaya Oblast of the Uzbek SSR), up to 80 per cent of the P. pruinosa Schrenk population was infested with the psyllid.

The formation of callus galls was previously attributed to the activity of bacteria causing the disease through the creation of a bacterial cancer of poplar.

The adult insect has a delicate green color on emerging from the gall. The wings are yellowish, with conspicuous venation, and clear. The body, up to the apex of the wings, measures 3.2-5.0 mm.

Emergence occurs from May to July, but on a large scale in June. There are two or three generations annually. The females lay their eggs one at a time in the bark. The eggs overwinter.

The nymphs develop in globose galls. The first-instar nymphs are whitish, and when inside the galls are covered with a white down. The body is flattened. In the final stage the nymphs attain a length of 2.5-3.2 mm and a width of 1.2-1.5 mm. Pronotum, thorax, wing buds and legs yellowish, abdomen a lettuce-greenish color, ocelli red. The nymphs are completely mobile. On the branches of freshly planted windbreak trees they die after 5-8 days, because the galls dry up. Under laboratory conditions or in gardens the final-instar nymphs (in open galls) take one hour and twenty minutes to change into the adult form. Adult individuals were obtained from galls collected on 20 June three days later (23 June).

The galls are globular swellings on yearling, second-year or older shoots and branches of turanga, 3-12 mm or more in diameter, and also on the median part of the trunk. They are sometimes found on shoots 1.0-1.2 mm in diameter.

Fig. 1 - Branch of the blue turanga, Populus pruinosa Schrenk, affected with galls of the psyllid Egeirotrioza.

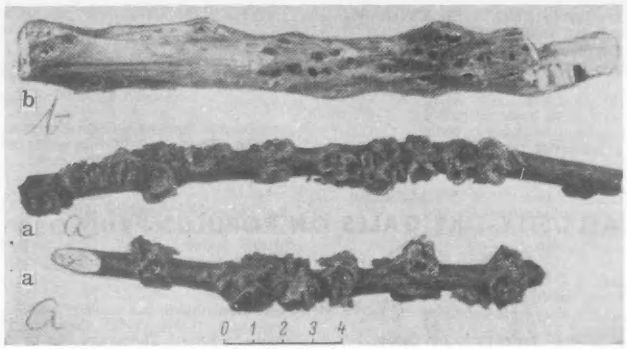

Fig. 2 - a - branches of P. pruinosa with opened callus galls; b - the wood under psyllid galls.

The inside of the gall is filled with a green parenchyma. The outside is covered with the same kind of primary bark as the shoot. The galls measure 6.0-15.0 x 3.0-8.0 mm. There are usually either one or two chambers. Of 500 galls taken for examination, 350 were single-chambered; 380 contained healthy nymphs, 120 contained dead ones. The latter were found mainly in the bicameral galls.

As the larvae grow the galls swell and burst, first into two parts, (transversely), later into three or four parts, exposing the inside, which is greenish at first but acquires a brownish color in four or five days. The bicameral galls open unevenly. The walls dry and become hard (Fig. 2, a), while the wood on shoots and branches where galls have formed becomes gnarled and harder to a depth of 10 mm. An inverted cone-shaped cavity filled with green fibrous bark tissue is found in the wood, under the galls. When the bark is stripped off, the wood is found to be pitted and covered with tubercles all over (Fig. 2, b).

A punctate aperture 0.2-0.3 mm in diameter and closed with cortex can often be seen on top of the gall, on its outer walls. There are two such openings on the bicameral type. This seems to be where the eggs were laid and the larvae entered the bark.

As the psyllids will colonize the same shoots and branches several times, the number of galls is high. On 24 September 1957, 72 of them were found on part of a P. pruinosa trunk (Syr-Dar'ya) measuring 10 cm in length and 1.4 cm in diameter. Of these, two were closed (healthy), 16 opened (old) and 54 opened (fresh).

On a 50 cm length of branch, 14 mm in diameter, of a similar tree in the Amu-Dar'ya region, there were 49 galls at the end of August. On another tree, 7 cm in diameter and 4.2 m high, there were 68 branches of which 62 were infested with psyllid galls. The galls are most often concentrated in the top part of the crown, starting at a distance of 40 cm from the trunk.

The activity of the psyllids causes the shoots and branches to wither and shrivel; the leaves roll, turn brown and wither, and a gall-riden tree loses all decorative appeal.

In the Amu-Dar'ya region galls caused by the turanga shoot psyllid, Trioza rufa Log., are often found at the same time as the Egeirotrioza galls. The weevil Apion rests in the latter during the hot part of the day.

A method of controlling the psyllid in tugay forests, which deserves attention, is to dust the crowns of the trees with 12% BHC during the emergence season. In towns one or two sprayings with mineral-oil emulsions of DDT and BHC during the same period will be found effective; heavily gall-ridden branches should be pruned. Tests of such organophosphorus preparations as Thiophos, Metaphos, octamethyl and so forth are likely to offer good prospects for psyllid control.

THE LONGICORN BEETLE (COLEOPTERA. CERAMBYCIDAE) FAUNA OF SAKHALIN

G. O. KRIVOLUTSKAYA

I

References to the longicorn beetles of Sakhalin in the literature are very incomplete. There are as yet no summaries. Plavil'shchikov (1932, 1936, 1940) only touches on general distribution. Japanese investigators (Matsumura and Tamanuki, 1927; Tamanuki, 1933; Matsushita and Tamanuki, 1935, 1937) give lists and descriptions of some species with short notes on their locations. These papers make almost no mention of the biology, harmful activity, biotopic distribution and zoogeographic nature of the longicorn beetle fauna of the island. Moreover, an examination of the Japanese collections (which are at present kept at the Far Eastern Branch of the USSR Academy of Sciences) revealed that many identifications by the Japanese entomologists were incorrect. Thus, Chlorophorus herbsti Brahm. had been identified as Chlorophorus sexmaculatus Motsch., Tetropium gracilicorne Reitt. had been reduced to the rank of subspecies under Tetropium castaneum L., Leptura sequensi Reitt. as Leptura dubia Scop., Acmaeops angusticollis Gebl. as a variant of Acmaeops smaragdula Fabr. and so on. In the present paper we have made use of our own collections and observations, the Japanese collections and references in the literature. The paper contains information on the distribution by habitat of the majority of species throughout the island, their harmful activity and the zoogeographic nature of the longicorn beetle fauna of Sakhalin. The paper ends with an annotated list of all the species recorded on the island.

The work was carried out in the Sakhalin Branch of the USSR from 1949 through 1954.

II

There is an extreme diversity of natural conditions on Sakhalin. This is due to the great length of the island from north to south (more than 900 km), the mountainous nature of the terrain and the cool, humid climate, which has special features in the different regions. The vegetation of Sakhalin consists in the main of trees and shrubs, which are differentially distributed throughout the island. The following subzones can be distinguished: 1) larch forests, 2) dark coniferous forests,[1] 3) dark coniferous forests with an admixture of broad-leaved species and intrazonal deciduous forests.

The larch forests occupy the north of Sakhalin (approximately to latitude 51°30'N.). They consist mainly of Dahurian and Kamchatka larch (Larix daurica and L. kamtschatica). The broad-leaved species found to the south (elm, maple, oak and ash) are not present. Fir and pine plantations are only to be found on well drained sectors among the larches. Thickets of large herbaceous plants are only found on small areas beneath the canopy of valley forests. Northern elements typical of the Okhotsk continental seaboard and Kamchatka are considerably more widespread.

The longicorn fauna of this vegetation subzone consists of boreal palearctic species associated with the larch and with the small areas of dark coniferous forest. It is noticeably scantier than in the more southerly districts. Species commonly encountered include Xylotrechus altaicus Gebl., Acanthocinus carinulatus Gebl., Monochamus urussovi Fisch., M. sutor L., Leptura virens L., and Pogonocherus fasciculatus Deg. Xylotrechus altaicus Gebl. is, apparently, only found in the north of the island.

Dark coniferous forests of Jeddo spruce (Picea ajanensis) and Sakhalin fir (Abies sachalinensis) cover the rest of Sakhalin to the south of the larch forest subzone. In the center of the island (north of 48° N) spruce predominates and the most typical formation is dark coniferous moss forest. South of latitude 48° N the nature of the dark coniferous taiga changes. Fir begins to be predominant in the stands and the green moss dark coniferous forests give way to spruce and fir forests with fern cover. Near the seacoasts a tree form of yew (Taxus cuspidata) makes its appearance.

Above the dark coniferous taiga belt in the mountains one finds sparse forests of stone birch, usually with underscrub of Kuril bamboo (Sasa kurilensis).

The longicorn beetle fauna of the dark coniferous taiga is much richer than that of the larch forests. It consists in the main of boreal palearctic species associated with the spruce and fir. Species commonly encountered, in very large numbers in some places, include Monochamus urussovi Fisch., M. sutor L., Rhagium inquisitor rugipenne Reitt., Leptura variicornis Dalm., L. succedanea Lewis, L. scotodes H. W. Bat., L. sequensi Reitt., L. virens L., Strangalia quadrifasciata L., S. arcuata Panz., S. aethiops Poda, Judolia sexmaculata f. parallelopipeda Motsch., Acmaeops septentrionis Thoms., Acanthocinus carinulatus Gebl., and Tetropium castaneum L.

The great spruce longhorn beetle (Monochamus urussovi Fisch.) and the lesser spruce longhorn beetle (M. sutor L.,) are especially plentiful in the coniferous forests. Owing to frequent forest fires and the natural drying out of spruce and fir forests these species find conditions in some of the central districts of Sakhalin especially favorable to their development.

Species that are here encountered less frequently and in smaller numbers include Monochamus saltuarius Gebl., M. impluviatus Motsch., Sachalinobia koltzei Heyden, Pachyta lamed L., P. bicuneata Motsch., Oedecnema dubia Motsch., Strangalina attenuata L., Gaurotes virginea L., Cyrtoclytus capra Fald., C. caproides H. W. Bat., Chlorophorus sexmaculatus Motsch. and some others.

Valleys and flood plain areas are covered by deciduous forests consisting of Japanese poplar (Populus maximoviczii), poplar-like willows, Chosenia macrolepis in places, willows, and Manchurian alder (Alnus hirsuta). Elms (Ulmus propinqua, U. laciniata), Manchurian ash (Fraxinus mandschurica) and hawthorn (Crataegus chlorosarca) are also important elements in the valley forests of the southern districts, where maple (Acer pictum) and, in places, oak (Quercus mongolica) are also encountered more frequently. Elements from the southern flora, such as bircherry (Padus ssiori), snowball tree (Viburnum furcatum), aralia (Eleuterococcus senticosus) evergreen shrubs (Ilex crenata and Skimmia repens) and lianas (Actinidia kolomikta), become common and fairly widely distributed.

The grasses beneath the canopy of the valley forests and in the water meadows consist of rough bluejoint reedgrass (Calamagrostis langsdorfii) and large herbaceous plants

[1] Tolmachev (1955) distinguishes two independent subzones in the dark coniferous forests: green moss dark coniferous forests, in which spruce predominates, and dark coniferous forests in which fir predominates. Since the longicorn beetle fauna of both these subzones is composed of the same species, I have found it convenient to treat them as a single dark coniferous forest zone in presenting my materials.

including butterbur (Petasites amplus), angelica (Angelica ursina), nettle (Urtica takedena), dropwort (Filipendula kamtschatica) and groundsel (Senecio palmata), with Polygonum sachalinense south of 48° N.

In the valley and flood plain deciduous forests and along the western seaboard, especially in the vicinity of Cape Lamanon, where climatic conditions are less severe, one frequently encounters Stenocorus amurensis Kr. on willows and Mesosa myops Dalm. on alders in company with species that are rare in the center of the island (Strangalia thoracica Creutz., Chlorophorus sexmaculatus Motsch., Cyrtoclytus capra Germ., and Allosterna tabacicolor bivittis Motsch.). Although the general predominance of palearctic boreal species is maintained in the southern districts, the longicorn beetle fauna is augmented by southern elements, apparently in connection with the warmer climate and the greater assortment of hardwood species here. Many species which are absent from the Poronaysk, Uglegorsk, Makarov and other central districts, or are only found in isolation, become commoner in the south. These species include Leptura cyanea Gebl., Strangalia vicaria H. W. Bat., Megasemum quadricostulatum Kraatz, Molorchus minor L., Aromia moschata orientalis Plav., Leontium viride Thoms., Xylotrechus adspersus Gebl., X. rusticus L., Cyrtoclytus capra Germ., C. caproides H. W. Bat., Chlorophorus gracilipes Fald., Mesosa japonica H. B. Bat., Nivellia sanguinosa Gyll., Evodinus borealis Gyll., E. interrogationis L., Acmaeops angusticollis Gebl., Plectrura metallica sachalinica Jacob., Saperda interrupta Gebl., and Eutetrapha metallescens v. chrysargyrea H. W. Bat.

The extreme southwest of southern Sakhalin, embracing the territory from Cape Kril'on to Kholmsk, has distinctive natural conditions. Climatically the southwestern seaboard has a fairly prolonged warm summer and a mild snowy winter, and it combines high temperatures with considerable humidity. Fragments of deciduous forest containing elements of subtropical flora have therefore been retained in this area. The basic vegetation throughout this territory is dark coniferous forest in which fir predominates. These forests include admixtures of tree yew (Taxus cuspidata), Sakhalin cork (Phellodendron sachalinense), oak (Quercus crispula), maple (Acer pictum), Sakhalin cherry (Cerasus sachalinensis), aralia (Aralia elata), hydrangea (Hydrangea paniculata) and, in the extreme south, Kalopanax ricinifolium.

Several investigators (Kurentsov, 1948; Violovich, 1956, 1960a, 1960b; Krivolutskaya, 1958) have noted that, from the point of view of its entomological fauna, the extreme southwest is an area in which southern endemic and relict species are concentrated. The number of species of longicorn beetles to be found in the extreme southwest does not, however, differ greatly from their representation in the south of the island as a whole, except that some species are present in larger numbers (Strangalia thoracica Creutz., S. vicaria H. B. Bat., Leptura cyanea Gebl. and others) and some comparatively rare species are also encountered (Distenia gracilis Bless., Omphalodera puziloi Solksy, Gaurotes ussuriensis Bless., Grammoptera chalybeella H. W. Bat., Strangalia ochraceofasciata Mats., Necydalis solida H. W. Bat., Leontium viride Thoms., Cyrtoclytus caproides H. W. Bat., Plectrura metallica v. sachalinica Jacob., Acanthocinus stillatus H. W. Bat.).

Owing to the maritime climate and the levelling of air temperature and humidity, vertical zoning in the distribution of insects in general and longicorn beetles in particular is not so marked at different altitudes as, for example, in the Primor'ye and the Sikhote-Alin mountains (Kurentsov, 1948). Species that are widely distributed in the valleys are also found high in the mountains and even on bare ridges. In illustration we would mention that we have found Plectrura metallica v. sachalinica Jacob., Acanthocinus carinulatus Gebl. and Cyrtoclytus caproides H. W. Bat., which are common in the valleys, on the summit of Mt. Ichara (1023 m above sea level).

There have been considerable shifts in the phenological development periods of the longicorn beetles on Sakhalin by comparison with the mainland. The majority of species fly approximately one month later than at the same latitudes on the mainland. Flight commences in the last 10 days of July and continues until the end of August.

Species that are so plentiful as to cause considerable losses to forestry on the island include Xylotrechus altaicus Gebl., which damages larch, in the northern districts, and Monochamus urussovi Fisch., M. sutor L., Rhagium inquisitor rugipenne Reitt., Acanthocinus carinulatus Gebl., Tetropium castaneum L. and representatives of the genera Leptura and Strangalia, which damage spruce and fir, in the central and southern districts. Secondary pests breed in large numbers on Sakhalin in spruce and fir forests that are drying out naturally in the Uglegorsk and Krasnogorsk districts, at places where there have been slash fires and in lumbering areas, if the felling area is not properly cleared up or if timber is stored without being disbarked in the forest during the summer. Owing to a succession of forest fires over a number of years longicorn beetles and bark beetles bred in large numbers over considerable areas in the Uglegorsk, Krasnogorsk, Poronaysk and other districts in 1952 and 1953.

Slash fires in the spring and early summer are normally followed by colonization by longicorn beetles in late July and August of the same year, when the majority of species begin active flight. In the second summer after the fire one can normally hear a continuous crunching sound at such places as the larvae eat their way through the timber. In some sectors the burnt trunks are highly infested: there may be 30 or more entrance holes to a running meter of trunk. Areas of slash fires that occur in the late summer are normally colonized in the second year after the fire.

In districts where Monochamus urussovi Fisch. and M. sutor L. breed in large numbers they do great damage to adjacent healthy forests during their active flight period, by gnawing the bark of thin branches, thus causing the needles to turn yellow and fall. One controls mass species of longicorn beetle by preventive and sanitary measures, but these are not always observed in the conditions on Sakhalin. In order to eradicate mass breeding areas for a number of species of longicorn beetles felled areas must be promptly and thoroughly cleared up, felled timber must be disbarked and slash fires and timber past its prime must be dealt with promptly and effectively.

III

I have based my zoogeographic analysis of the longicorn beetle fauna of Sakhalin on Semenov-Tyan-Shanskiy's classificatory scheme of the Palearctic region (1936), developed from data for the geographic zoning of the Coleoptera, with corrections from my own findings.

The general impression created by the fauna under consideration is that it is mixed. It is made up of the following zoogeographic elements: 1) boreal palearctic, 2) holarctic, 3) eastern palearctic (Trans Siberian and East Siberian groups), and 4) palearcheartic (also composed of two groups: the northeast Chinese and Sakhalin-Japanese groups).

1) The boreal palearctic group of species, which is widely distributed throughout the Palearctic forest zone, has the largest number of species (32). Since they are associated with coniferous forests, the representatives of this group are found all over Sakhalin. They include: Leptura variicornis Dalm., Evodinus borealis Gyll., E. interrogationis L., Acmaeops marginata F., A. septentrionis Thoms., Allosterna elegantula Kraatz, Strangalia thoracica Creutz., S. quadrifasciata L., S. arcuata Panz., S. aethiops Poda, Strangalina attenuata L., Spondylis buprestoides L., Necydalis major L., Criocephalus rusticus L., Asemum striatum L., A. punctulatum Bless., Tetropium castaneum L., Molorchus minor L., Callidium coriaceum Payk., Xylotrechus rusticus L., Clytus arietoides Reitt., Cyrtoclytus capra Germ., Lamia textor L., Monochamus urussovi Fisch., M. sutor L., M. galloprovincialis Oliv., Pogonocherus fasciculatus Deg., Acanthoderes clavipes Schrank, Acanthocinus carinulatus Gebl. and Agapanthia villosoviridens Deg.

2) The holarctic group is represented by the following species: Pachyta lamed L., Acmaeops pratensis Laich., Judolia sexmaculata parallelopipeda Motsch., Callidium violaceum L. This group is not rich in species.

3) Eastern palearctic species are represented by two groups: the Trans Siberian and the East Siberian.

a) In the Trans Siberian grouping we place species found in the forest zone from the Far East to west of the Urals. These taiga elements account for 18.5% of the fauna of Cerambycidae on Sakhalin. They are most richly represented in the dark coniferous forests. The group includes: Evodinus variabilis Gebl., Gaurotes virginea L., Acmaeops angusticollis Gebl., Allosterna tabacicolor bivittis Motsch., Leptura sequensi Reitt., L. renardi Gebl., Judolia longipes Gebl., Oedecnema dubia Motsch., Strangalia duodecimguttata Fabr.,

Asemum amurense Kr., Tetropium gracilicorne Reitt., Pronocera brevicollis Gebl., Xylotrechus altaicus Gebl., X. adspersus Gebl., X. hircus Gebl., Chlorophorus gracilipes Feld., Monochamus impluviatus Motsch., M. saltuarius Gebl., Mesosa myops Dalm., Acanthocinus griseus F.

b) East Siberian palearctic species are found to the west as far as Lake Baykal. They are poorly represented on Sakhalin, where there are only 8 species: Rhagium inquisitor rugipenne Reitt., Necydalis sachalinensis Mats. et Taman., Aromia moschata orientalis Plav., Chlorophorus motschulskyi Gangbl., Agapanthia daurica Ganglb., Leptura sequensi Reitt., Saperda octomaculata Bless., and S. balsamifera Motsch. Rhagium inquisitor rugipenne Reitt. is the most widely distributed; the remaining species are mainly found in the central and southern districts of the island and many are rare.

4) Palearchearctic species are represented by northeast Chinese and Sakhalin-Japanese insular elements.

a) The northeast Chinese group consists of the following 28 species: Distenia gracilis Bless., Stenocorus amurensis Kr., Pachyta bicuneata Motsch., Evodinus bifasciatus Oliv., Sachalinobia koltzei Heyd., Gaurotes ussuriensis Bless., Acmaeops minuta Gebl., Omphalodera puziloi Solsky, Pseudopidonia debilis Kr., Grammoptera chalybeella H. W. Bat., Strangalomorpha tenuis Solsky, Leptura cyanea Gebl., L. succedanea Lewis., Megasemum quadricostulatum Kr., Obrium gracile Plav., Leontium viride Thoms., Rhopalopus ruficollis Mats., R. aurantiicollis Plav., Chlorophorus sexmaculatus Motsch., Olenecamptus octopustulatus Motsch., Asaperda agapanthina H. W. Bat., Acanthocinus stillatus H. W. Bat., Saperda interrupta Gebl., Eutetrapha metallescens Motsch., E. variicornis H. W. Bat., Menesia sulphurata Gebl. and Glenea relicta Pasc.

The majority of these species are found in the south of the island. Many of them are rare and have only been recorded once on Sakhalin. The richness of the palearchearctic forms shows that there must once have been close connections between the islands and the southern sectors of the mainland. This is also confirmed in other insect groups, such as the Syrphidae (Violovich, 1956) and bark beetles (Krivolutskaya, 1958).

b) Insular endemic species belonging to the Sakhalin-Japanese complex are found on Sakhalin, the Kuril Islands and the islands of Japan. They occupy a prominent place in the fauna of the island. The group includes: Evodinus mannerheimi Fald., Grammoptera cyanea Taman., Leptura scotodes H. W. Bat., Judolia cometes H. W. Bat., Strangalia circaocularis Pic., S. vicaria H. W. Bat., S. xanthoma H. W. S. regalis H. W. Bat., S. ochraceofasciata Motsch., Necydalis pennata Lewis, N. solida H. W. Bat., Xylotrechus clarinus H. W. Bat., Plectrura metallica H. W. Bat. v. sachalinica Jacob., and Cyrtoclytus caproides H. W. Bat.

Many of the species in this group are rare on Sakhalin and are only encountered singly, mainly in the south of the island, whereas they are more common and plentiful on the Japanese Islands. This is because after the general cooling of the climate in the late Tertiary and early Quaternary periods some southern forms were preserved in the extreme southwest of the island in what remained of the deciduous forests.

IV

There is a great diversity of species of longicorn beetle in the forests of Sakhalin. Up to the present 108 species of longicorn beetles belonging to 51 genera have been recorded on Sakhalin.

1. Distenia gracilis Bless. Rare on Sakhalin: found in the spruce and fir forests of the extreme southwest. I have found an isolated specimen in the Gornozavodsk district. Found in the southern districts of the Khabarovsk subdistrict (kray), the Primor'ye, on Sakhalin, and in northeastern China, Korea and Japan.

2. Rhagium inquisitor rugipenne Reitt. Common throughout the island. Does considerable damage to weakened trees and prepared lumber (spruce, fir and larch). In localities far from the sea a few beetles appear as early as the second half of May on warm days. Mass flight occurs between the end of June and the beginning of August. The larva lives beneath the bark, where it bores large passages that are tightly packed with borings. Pupates beneath the bark, without penetrating into the timber, in pupal chambers tightly surrounded by frass and wood fibers. Found in East Siberia from Lake Baykal to the Pacific (in the Khabarovsk subdistrict and the Primor'ye), on Sakhalin and in northeast China and Korea.

3. Stenocorus amurensis Kr. Common in southern Sakhalin, abundant in places. I made quite a large collection of these beetles in the Uglegorsk district near Krasnopol'ye and in the Lesogorsk and south Sakhalin districts. The beetles live in valleys and catchment basin forests where willows grow. Flies between the end of June and the beginning of August. Found during the flight period on angelica branches. Larvae develop in the wood of willow. Length of the generation unknown. No economic significance. Found in the southern districts of the Khabarovsk subdistrict, the Primor'ye, central and southern Sakhalin, northeastern China and Korea.

4. Pachyta lamed L. Both the typical form and the aberration x-nigrum Hellen are found in the spruce and fir forests of central and southern Sakhalin. Quite rare. Flies in July and August. Its area embraces the taiga zone of European Russia, Western and Eastern Siberia, the Khabarovsk subdistrict (north of the Amur), Sakhalin, Mongolia, the north and center of Japan and Alaska.

5. Pachyta bicuneata Motsch. Widely distributed in the spruce and fir forests of Sakhalin. Flight, during which the insects are found on umbelliferous flowers begins in the middle of July and continues to the end of August. According to Kurentsov (1950) the larvae develop in the Primor'ye in felled cedars, Korean spruce and Dahurian larch. Tamanuki (1933) reports that Ab. bisbimaculata Pic and ab. incolumis Heyd. are only encountered in the center and south of the island. Found in the south of the Khabarovsk subdistrict, the Primor'ye, on Sakhalin, in northeast China, Korea and northern Japan.

6. Evodinus bifasciatus Oliv. From our collections and the data of Japanese entomologists, the species is found in southern Sakhalin (in the Dolinsk, South-Sakhalin, Korsakov and other districts). Encountered fairly infrequently, on flowers. Flies in the second half of June and in July. Known from Eastern Siberia east of Transbaykaliya, from the Khabarovsk subdistrict, from Sakhalin, from northeastern China and Tibet, Korea and northern and central Japan.

7. Evodinus variabilis Gebl. Plavil'shchikov (1936) ascribes this species to northern Sakhalin. I have not found it, nor is it mentioned by the Japanese investigators. It is clearly extremely rare on the island. Distributed in the northeast of European Russia, in the Urals and Siberia, on Kamchatka and northern Sakhalin, in northern Mongolia, northeastern China and northern Korea.

8. Evodinus borealis Gyll. Found in spruce and fir forests on Sakhalin. Single specimens found on umbellifers. Flies from the middle of July through August. Biology unstudied. Area extremely extensive: the north of European Russia, Siberia (in the taiga zone), Sakhalin, northern Mongolia, northeastern China, Korea, northern and central Japan; in Western Europe it is found in the mountains. Rare everywhere.

9. Evodinus interrogationis L. Widely distributed in the spruce and fir forests of Sakhalin. In addition to the typical form there are two colored aberrations on the island: ab. punctatus Fald., found, according to Plavil'shchikov (1936) in the Amur Basin in Siberia, on Sakhalin and in northeastern China, and ab. amurensis Kr., found in the Amur Basin, the Primor'ye and the forests of Sakhalin. The larvae apparently develop in spruce and fir timber. The area embraces the taiga belt of European Russia, the Caucasus, Siberia, the Khabarovsk subdistrict and the Primor'ye, Sakhalin, northern Mongolia, northeastern China, Korea,

northern and central Japan and Western Europe.

10. Evodinus mannerheimi Fald. Plavil'shchikov does not include this species in the fauna of the USSR. Tamanuki (1933) reports the discovery of several specimens in northern Sakhalin near Pul'vo (the Schmidt Peninsula) in August 1922. I have not taken this species. It is not to be found in the collections. Tamanuki's references to its occurrence in Eastern Siberia are apparently mistakes.

11. Sachalinobia koltzei Heyd. The species is common in the spruce and fir forests of Sakhalin. Widely distributed in the central and southern districts of the island, but encountered as isolated specimens, usually on felled Jeddo spruce and Sakhalin fir. Not observed on flowers. Flight period greatly prolonged: the beetles appear at the end of June and fly until the end of August. Larvae develop in the timber of dead spruce and fir. No economic significance. Found in the Amur Basin, in the Khabarovsk subdistrict and the Primor'ye, on Sakhalin, and in northeastern China, Korea and Japan.

12. Gaurotes virginea thalassina Schrank. The beetles are encountered quite frequently on flowers in central and southern Sakhalin. They live in dark coniferous forests, within which they ascend mountains to the upper limit of the forest. Flight period from the middle of July to the end of August. Larvae develop in spruce and fir timber. Found in Siberia, on Sakhalin, and in northern Mongolia, northeastern China and northern Korea.

13. Gaurotes ussuriensis Bless. I have not found this species on the island, nor is it in the Japanese collections in the Far Eastern Branch of the USSR Academy of Sciences. Tamanuki (1933) states that it is found on the southwestern seaboard of Sakhalin. Flight period not established. Biology unstudied. Found in the Far East: in the Amur Basin, the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and in northeastern China and northern Korea.

14. Acmaeops marginata F. Plavil'shchikov (1936) states that this species is found on Sakhalin. I have not discovered it, nor do the Japanese entomologists list it for the island. The species is clearly very rare. Found in the northern forests of European Russia, in Siberia, the Khabarovsk subdistrict, on Kamchatka and Sakhalin and in northern Mongolia and northeastern China.

15. Acmaeops pratensis Laich. A widely-distributed holarctic species. Quite common on Sakhalin. The beetles are encountered on flowers. Flight period in July and August. In forests on the mainland the larvae develop on pines. On Sakhalin, where there is no pine, the species clearly develops on other conifers. Found in European Russia, the Caucasus, Siberia, the Khabarovsk subdistrict, on Kamchatka and Sakhalin, in Soviet Central Asia (in mountain forests), in northern Mongolia, northeastern China, northern Korea, Western Europe and North America.

16. Acmaeops septentrionis Thom. Found in central and southern districts on the island. Encountered fairly often in spruce and fir forests on the flowers of umbellifers. Flight period from the middle of July to the middle of August. Biology not studied in detail. The larvae probably develop on the Jeddo spruce, since Japanese entomologists report its discovery on the trunks of these trees. No economic significance. Found in the taiga zone of European Russia, Siberia, the Khabarovsk subdistrict, on Sakhalin and in northern Mongolia and northeastern China.

17. Acmaeops angusticollis Gebl. A taiga species frequently found on flowers in the spruce and fir forest area. More common on Sakhalin in the center and south. Flight period from the last 10 days in July to the middle of August. Not listed as a pest. Found in Siberia, the Khabarovsk subdistrict, on Sakhalin and in northern Mongolia, northeastern China and Korea.

18. Acmaeops (Dinoptera) minuta Gebl. The species is, apparently, extremely rare. I have not discovered it on the island, nor is it listed for Sakhalin by the Japanese entomologists. However, Plavil'shchikov (1936) states that it is present on Sakhalin, without mentioning where and when the species was collected. The duration of the flight period and the biology are unknown. Known from Eastern Siberia (to the east of Nerchinsk), from the Khabarovsk subdistrict and the Primor'ye, from Sakhalin and from northeastern China and Korea.

19. Omphalodera puziloi Solsky. According to Plavil'shchikov (1936), this species belongs to the palearchearctic subregion and is found on southern Sakhalin. I have not found it, it is not present in the Academy's collections, nor is it cited in the Japanese literature that I have been able to consult. Found in the Amur Basin, the basin of Lake Khanka, in the Primor'ye, on southern Sakhalin, and in northeastern China, Korea and Japan.

20. Pseudopidonia debilis Kr. Attributed to Sakhalin by Plavil'shchikov (1936). I have not found it, nor do the Japanese investigators list it for the island. Biology unstudied. Found in the Amur Basin and the Primor'ye, on Sakhalin and in Korea, northeastern China and Japan.

21. Grammoptera chalybeella H. W. Bat. Very rare on Sakhalin, where it is found in the south. Flight period in the first half of August; biology not studied in detail. I have not found the species. Known from the Primor'ye, southern Sakhalin and central Japan.

22. Grammoptera cyanea Taman. Described by Tamanuki (1933) from one male, collected in the South Sakhalin district. I have not found it and Plavil'shchikov (1936) thinks that it is a doubtful species.

23. Allosterna tabacicolor bivittis Motsch. Widely distributed on Sakhalin: especially plentiful in the south where the incidence of deciduous trees in the forests increases. Found in the main in valleys and does not ascend high into the mountains. During the flight period, at the end of July and in August, large numbers of these beetles gather on angelica flowers. In addition to ab. bivittis Motsch. one encounters darker specimens of ab. fusca Matsusita, which is also common on the island. The larvae develop in the timber of willows, maples, elms and other deciduous species. Known from Siberia, Sakhalin, northeastern China, Korea and Japan.

24. Allosterna elegantula Kr. Extremely rare on Sakhalin, where it is mainly found in the southern districts. Larvae develop on deciduous species. Biology little studied. Flight period July and August; the beetles feed on flowers. Var. debilis Taman., described by Tamanuki (1933) from one male collected in the South Sakhalin district is open to doubt. I have not taken the species. Found in the Amur Basin, the Primor'ye, on Sakhalin and in northeastern China and northern Korea.

25. Nivellia sanguinosa Gyll. Found throughout Sakhalin, but encountered fairly infrequently. Develops on conifers. Flight period fairly prolonged; the first beetles appear by the middle of June and fly throughout July. No economic significance. The area of the species embraces the taiga zone of European Russia, Siberia, the Khabarovsk subdistrict and the Primor'ye, Sakhalin, northern Mongolia, northeastern China and Korea.

26. Strangalomorpha tenuis Solsky. The species is clearly very rare on the island. There are no specimens in our collections or in those kept by the Academy's Far Eastern Branch. Plavil'shchikov (1936) states that it is found on Sakhalin. Known from the central sector of the Amur Basin, the Primor'ye, Sakhalin, northeastern China, Korea, and Japan.

27. Leptura (Anoplodera) cyanea Gebl. Found in the center and south of Sakhalin. More plentiful in the southern districts, among deciduous trees

along the western seaboard. The beetles are found on umbellifer flowers, sometimes in large numbers. Flight period from the last 10 days in July to the middle of August. Found in Siberia (east of Lake Baykal), in the Khabarovsk subdistrict, on Sakhalin, in northern Mongolia, northeastern China, Korea and Japan.

28. Leptura variicornis Dalm. A common and widely distributed species found in coniferous forests all over the island. Flight period in the last 10 days in July and in August. Large numbers of the beetles are found on angelica flowers. Has been found to be especially plentiful on slash fire areas and dying plantations in the Poronaysk and Uglegorsk districts and in some other places. The larvae develop in spruce timber. Does considerable damage to burnt and weak trees and affects the quality of the timber. Ab. nigromarginata Taman. is quite rare. The species has an extensive area, embracing European Russia (mainly in the north), Siberia, the Khabarovsk subdistrict and the Primor'ye, Sakhalin, northern Mongolia, northeastern China, Korea and Japan.

29. Leptura succedanea Lewis. At least as widely distributed on Sakhalin as the previous species, but not quite so numerous. Found in spruce and fir forests. Flight period from mid July to the end of August. The color variant ab. trisignaticollis Pic. has been reported on Sakhalin. Known from the Amur Basin, the basin of Lake Khanka, Sakhalin, northeastern China, Korea and Japan.

30. Leptura scotodes H. W. Bat. Both the typical form and the color variants ab. masculina Plav. and ab. nipponensis Pic are found on the island, in the center and south, where it is extremely plentiful. During the flight period the beetles congregate in large numbers on flowers, mainly umbellifers. Flight period somewhat prolonged, continuing from mid July through August. The larvae develop in the wood of Sakhalin fir. There is apparently one generation a year. Known from Sakhalin and Japan. Probably an insular endemic species.

31. Leptura sequensi Reitt. Common on Sakhalin, where it is found in the center and south. The beetles are found on flowers in the dark coniferous forest belt, sometimes in large numbers. Flight period in the second half of July and the first half of August. The larvae develop in the wood of dead spruce and fir, and damage felled timber in some areas, if it is stored in the forest for the summer. Found in Siberia, the Khabarovsk subdistrict, on Kamchatka and Sakhalin, in northern Mongolia, northeastern China, Korea and Japan.

32. Leptura renardi Gebl. Quite rare on Sakhalin, but has been noted on flowers in the south of the island. Biology unstudied. Found in Siberia, the Khabarovsk subdistrict, on Sakhalin and in northern Mongolia and northern China.

33. Leptura virens L. Very common on the island. The habitat of the adult beetles is spruce and fir forests, forest glades and valleys, where they are found on flowers. Breeds in large numbers on slash fire areas and in plantations that are dying naturally as well as in lumbering areas. Clearly does damage by affecting the quality of timber. Mass flight begins in the second half of July and continues to mid August. Larvae develop in the wood of Jeddo spruce and Sakhalin fir. Widely distributed in European Russia, in the Urals and Siberia, on Kamchatka and Sakhalin, in the Khabarovsk subdistrict and the Primor'ye, northern Mongolia and northeastern China.

34. Judolia sexmaculata m. parallelopipeda Motsch. M. parallelopipeda Motsch. is found in Siberia and the palearchearctic subregion. Small numbers are found in coniferous forests all over Sakhalin. The larvae live on conifers. Flight period from late July to late August. The fairly extensive area of the species embraces European Russia, Siberia, the Khabarovsk subdistrict and the Primor'ye, Kamchatka, Sakhalin, northern Mongolia, northeastern China, Korea and Japan.

35. Judolia (Pachytodes) longipes Gebl. I have not found this species on the island, nor is it cited by Japanese authors. Ascribed to Sakhalin by Plavil'shchikov (1936). The species is extremely rare and its biology has not been studied. Found in Siberia, the Khabarovsk subdistrict, on Sakhalin, in northern Mongolia, northeastern China and northern Korea.

36. Judolia (Pachytodes) cometes H. W. Bat. Found in the center and south of the island. Fairly uncommon. Biology unstudied. Flight period in July and August. In addition to the typical form, ab. multimaculata Taman is also found on Sakhalin. Known from Sakhalin and Japan.

37. Oedecnema dubia Motsch. Common, but not very plentiful in the center and south of Sakhalin. The beetles visit flowers in the valleys and infest dark coniferous forests; they are found at high elevations in the forests. Flight period — late July and August. Larvae develop on spruce and fir. Found sporadically in European Russia, in the Urals, Siberia, the Khabarovsk subdistrict, on Sakhalin and in northern Mongolia, northeastern China, Korea and Japan.

38. Strangalia thoracica Creutz. Keeps to the western seaboard in the center of the island, where the climate is warmer and the coniferous forests contain a higher proportion of deciduous species. Somewhat more widely distributed in the south. Single beetles are found on dead deciduous trees. Flight period in late July and August. Biology unstudied. The variant ab. obscurissima Pic is found on Sakhalin. The area of the species embraces European Russia, Siberia, Sakhalin, northern Mongolia, northeastern China, Korea, Japan and Western Europe.

39. Strangalia quadrifasciata L. Common on Sakhalin, but not found in large numbers. Mainly found on umbellifer flowers in the valleys. The larvae develop beneath the bark of willows and birches. Flight period in the second half of July and the first half of August. No economic significance. Found in European Russia, Siberia, the Khabarovsk subdistrict, on Sakhalin, in northern Mongolia, northeastern China and northern Korea.

40. Strangalia arcuata Panz. Extremely common in the center and south of the island. The habitat of the adult beetles is dark coniferous forest, where they are found on umbellifer flowers during the flight period in July and August. The larvae live in spruce and fir timber in greatly weakened trees. In addition to the typical form, ab. humeridisjuncta Plav. and ab. mediodisjuncta Pic are also found on Sakhalin. Found in the coniferous forest zone of European Russia, in Siberia and the Khabarovsk subdistrict, on Sakhalin and in northern Mongolia, Korea, Japan, northern China, and Western Europe (in mountain forests).

41. Strangalia duodecimguttata F. Quite rare on Sakhalin, where it is found in the coniferous forests of the center and south. The beetles visit flowers. Biology insufficiently studied. Found in Siberia, the Khabarovsk subdistrict, on Sakhalin, in northern Mongolia, northeastern China and Korea.

42. Strangalia aethiops Poda. A common species in the center, south and north of the island. The larvae develop on deciduous trees (birch, oak, etc.). The habitat is therefore valley forests. Especially plentiful in the south and, in particular, in the extreme southwest, where the beetles congregate in large numbers on the flowers of angelica, buckthorn and other plants. Flight period in the second half of July and August. Widely distributed in European Russia, the Caucasus, Siberia and the Khabarovsk subdistrict, on Sakhalin and in northern Mongolia, northeastern China, Korea and Japan.

43. Strangalia circaocularis Pic, is extremely rare although described from Sakhalin. Flight period — July and August. Biology unknown. Reported from the southern districts of Sakhalin.

44. Strangalia vicaria H. W. Bat. Confined to southern Sakhalin, where it is sometimes found in large numbers. Habitat: spruce and fir forests with some deciduous trees. Flight period begins in late July and continues throughout August. During this time the beetles feed on the flowers of umbellifers and other plants. The larvae develop in the timber of Sakhalin fir, on trees that have been brought down by the wind, and may also infest felled timber. It does not apparently do serious damage. Known to exist in southern Sakhalin and in northern and central Japan.

45. Strangalia xanthoma H. W. Bat. Like the previous species this is an insular endemic species, which is extremely rare on Sakhalin, where it is known to exist in the south. Found in southern Sakhalin and northern Japan.

46. Strangalia regalis H. W. Bat. Rare on Sakhalin, found in Tamanuki's collections from the southwest coast. I have not found the species. It is found in southern Sakhalin and northern and central Japan.

47. Strangalia ochraceofasciata Motsch. An insular endemic species. Found in southern Sakhalin and the southernmost Kuril island (Kunashir). More plentiful in the extreme southwest among deciduous trees. Known to exist in southern Sakhalin, on Kunashir and in northern and central Japan.

48. Strangalia attenuata L. Found throughout the island, but comparatively infrequently and in small numbers. Flight period in August. I observed specimens in the early days of September 1950 in the Kirov region on flowers in an open larch and birch forest. Found in European Russia, the Caucasus, Siberia and the Khabarovsk subdistrict, on Sakhalin and in northeastern China, Korea, northern Iran, northeastern Turkey and Western Europe.

49. Necydalis major L. Attributed to Sakhalin by Plavil'shchikov (1936), with no indication of where it was found. No other references to the existence of the species on Sakhalin are to be found in the literature nor have I discovered it. Found in European Russia, Ciscaucasia, Siberia, the Khabarovsk subdistrict, on Sakhalin and in Western Europe.

50. Necydalis sachalinensis Mats. et Taman. Rare on the island, where it is known to exist in the south. I have not discovered it. Biology unstudied and food plants unknown. Found in the Amur Basin and the Primor'ye and on Sakhalin.

51. Necydalis pennata Lewis. I have not discovered this species, which Tamanuki (1933) reports as being found in the south. The area embraces southern Sakhalin and northern and central Japan.

52. Necydalis solida H. W. Bat. Rare. Described from Japan. Found in the south of Sakhalin by Tamanuki (1933). Apparently an insular endemic species. Known from southern Sakhalin and northern and central Japan.

53. Spondylis buprestoides L. A palearctic species found in the coniferous forest zone. The larvae develop on the roots of conifers, sometimes at a considerable depth. According to Plavil'shchikov (1940) it is found all over Sakhalin, but I have not discovered it. Widely distributed in European Russia, Transcaucasia, western Kazakhstan and Siberia and on Sakhalin.

54. Criocephalus rusticus L. Found all over the island. Especially plentiful in slash fire areas, in plantations of dying trees and on lumbering sites. Does considerable damage to felled timber. I have often found this species in the areas in which it breeds in large numbers in the center and south of Sakhalin. Flight period in July and August; during the flight period the beetles are found on the trunks of felled spruce and fir. On the island the larvae develop on Sakhalin fir. Found in Europe, Siberia, on Sakhalin, in Mongolia, northeastern China, Korea and Japan.

55. Megasemum quadricostulatum Kr. Common on Sakhalin. Found within the dark coniferous forest area, usually on the southwest coast. Flight period in July and August. Beetles and larvae are found on the fallen trunks of Jeddo spruce and Sakhalin fir. A pest of timber. Known from the Amur Basin, Sakhalin, Japan and Korea.

56. Asemum striatum L. Common in the spruce and fir forests of southern Sakhalin. Found in large numbers around slash-fire and lumbering areas. Flight period begins in the middle of July and continues throughout August. During the flight period the beetles can be observed crawling over spruce and fir trunks, but not on flowers. The larvae live in the wood of Sakhalin fir and do considerable damage to felled and prepared timber. Both the typical form and var. subsulcatus Motsch. are found on Sakhalin. The area embraces European Russia, the Caucasus, Siberia, Sakhalin, northeastern China, Korea, Japan and Chinese Dzhungariya.

57. Asemum amurense Kr. Plavil'shchikov (1940) states that the species is distributed throughout the island, but I have not discovered it. Its area embraces Siberia from the Altay onwards, the Amur Basin, Sakhalin, northeastern Mongolia and northeastern China.

58. Asemum punctulatum Bless. Found in the spruce and fir forest area on Sakhalin. Quite rare and not found in quantity. Flight period somewhat extended, lasting from June through August. Biology little studied. Found in the Amur Basin, the Primor'ye, on Sakhalin and in northeastern China, Korea and Japan.

59. Tetropium castaneum L. Found throughout the island, but is more common and plentiful in the south, where it apparently does considerable damage to timber. There are two forms on Sakhalin: m. fulcratum F. and m. aulicum F. Flight period from late June to early August. During the flight period the beetles can be found on tree trunks but not on flowers. Found in the coniferous forest zone of European Russia, in Siberia, the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and in Japan.

60. Tetropium gracilicorne Reitt. The species is apparently rare on Sakhalin and I have not discovered it. Kurentsov (1950) also notes that it is of rare occurrence in the Primor'ye. Plavil'shchikov (1940) ascribes the species to Sakhalin, without indicating its location on the island. Found in Siberia, the Khabarovsk subdistrict and the Primor'ye, on Sakhalin, and in Mongolia, northeastern China, Korea and Japan.

61. Obrium gracile Plav. Rare, known to exist in the Primor'ye and southern Sakhalin. Food plant unknown and biology unstudied. Tamanuki collected some specimens on the island near Novo-Aleksandrovsk (South Sakhalin district).

62. Molorchus minor L. Tamanuki's data (1933) and our collections locate this species in the coniferous forests of southern Sakhalin, where it is not very common. The larvae develop on Jeddo spruce and Sakhalin fir. Flight period in July. No economic significance here. Found in European Russia, Siberia, the Khabarovsk subdistrict and the Primor'ye, on southern Sakhalin, in Asia Minor, Iran, northeastern Turkey, Korea, northeastern China and Japan.

63. Aromia moschata orientalis Plav. Tamanuki and I have both found this species in the south of the island. It inhabits valley forests. Flight period — July and August. Found in the Amur Basin, on Sakhalin, in northern Mongolia, northeastern China, Korea and Japan.

64. Leontium viride Thoms. A palearchearctic species. Found on Sakhalin in the southern districts, where it is common and plentiful on the southwest coast on umbellifer flowers in the deciduous and mixed forests of the river valleys. Flight period in July and August. The larvae probably develop on deciduous trees. Biology unstudied. Found on Sakhalin and Kunashir, in northern, central and

southern Japan, on Formosa and in northern and central China.

65. Rhopalopus (Pronocerodes) ruficollis Mats. Very rare on Sakhalin. I have not found it, nor is it present in the Japanese collections kept at the Academy's Far Eastern Branch. Plavil'shchikov (1940) ascribes it to the south of the island. The habitat is deciduous forest. Biology unstudied. Known in the southern districts of the Primor'ye and southern Sakhalin.

66. Rhopalopus (Pronocerodes) aurantiicollis Plav. Like the previous species, this species is very rare. I have not found it, but Plavil'shchikov (1940) states that it occurs in southern Sakhalin. Biology unstudied. Food plant not established. Known to exist in southern districts of the Primor'ye and on southern Sakhalin.

67. Pronocera brevicollis Gebl. Rare on Sakhalin where it is found in the south. Its habitat is coniferous and mixed forests. The larvae develop on conifers. Biology not studied in detail. In addition to the typical form one also finds var. dahurica Motsch. and var. ruficollis Mats. on the island. Its area embraces Siberia, the Khabarovsk subdistrict, Sakhalin, northern Mongolia, northeastern China and Korea.

68. Callidium (Palaeocallidium) coriaceum Payk. An insect of the taiga zone, which is rare on the island. I have not found it, but Tamanuki (1933) reports its presence in southern Sakhalin. Found in the European taiga zone, Siberia, northern Mongolia, northeastern China, Korea and Western Europe.

69. Callidium violaceum L. Widely distributed on Sakhalin. The flight period is from May to July. According to Plavil'shchikov (1940) the larvae live in dead and even rotten wood of various conifers and deciduous trees. On the island it apparently develops on Jeddo spruce and Sakhalin fir. The area of the species embraces the coniferous and deciduous forests of European Russia, the Crimea, the Caucasus, Transcaucasia, Siberia, Sakhalin, northern Mongolia, northeastern China, Korea and Japan.

70. Xylotrechus altaicus Gebl. Found in the larch plantations of northern Sakhalin, where it does great damage to larch. The phenological developmental periods have not been established for Sakhalin. Not found in the center and south of the island. Found in Siberia from the Urals to the Pacific, and on northern Sakhalin.

71. Xylotrechus adspersus Gebl. Widely distributed on the island, mainly in the center and south, but not encountered very frequently. Valley and catchment basin deciduous and mixed forests and scrub provide the habitat. Flight period in late June and July. The larvae develop on willows (Salix cardyophylla). Known to exist in Siberia, on Sakhalin and in northern Mongolia, northeastern China and northern Korea.

72. Xylotrechus rusticus L. Found on southern Sakhalin in valley forests. The beetles attack birch trunks singly. Flight period in July. Its area embraces Europe, Siberia, Sakhalin, Korea, Japan, northeastern China, northern Mongolia, the Caucasus, Transcaucasia, northern Iran, and northeastern Turkey.

73. Xylotrechus clarinus H. W. Bat. I have not found this species on the island, where it is apparently quite rare. Tamanuki (1933) found it in the south. Flight period in July and August. Known to exist in southern Sakhalin and northern Japan.

74. Xylotrechus hircus Gebl. According to Plavil'shchikov (1940) the species is found throughout the island, but I have not encountered it, nor is it mentioned in the works of Japanese entomologists. It is clearly extremely rare. The area of the species embraces Siberia, the eastern Altay, Transbaykaliya, Sakhalin, northern Mongolia, northeastern China and northern Korea.

75. Clytus arietoides Reitt. Found in southern Sakhalin, primarily along the southwest coast. Rare. The habitat consists of deciduous and mixed forests. During the flight period in the second half of July and August the beetles settle on the flowers of angelica and other umbellifers. Found in European Russia (the northern forests) and Siberia, on Sakhalin and in northern Mongolia, northeastern China and Korea.

76. Cyrtoclytus capra Gebl. Quite common in the center and south, but most plentiful in the extreme south. Confined to dark coniferous forests. Flight period in the second half of July and the first half of August. The larvae live on conifers. Found in European Russia, Transcaucasia, Siberia, on Sakhalin and in Mongolia, northeastern China and Korea.

77. Cyrtoclytus caproides H. W. Bat. An insular endemic species. On Sakhalin it is confined to central and southern districts. In the center it is mainly confined to the west coast. Quite rare. The habitat consists of deciduous and mixed forests in valleys and catchment basins. Flight period in late July and the first half of August. During the flight period the beetles are found on umbellifer flowers. The larvae develop on birch. Known to exist in Sakhalin and Japan.

78. Chlorophorus sexmaculatus Motsch. Found in central and southern Sakhalin. Quite common. Lives in valley forests. Flight period from mid July to the end of August. The beetles attack the flowers of umbellifers and other plants. Found in the Amur Basin, the Khabarovsk subdistrict, on Sakhalin and in Mongolia, north and northeastern China and Korea.

79. Chlorophorus motschulskyi Gangib. Found throughout the island but is comparatively rare. Encountered in deciduous and mixed forests in valleys. Flight period in August. The larvae develop on birches and probably on other deciduous species. Found in Eastern Siberia from Transbaykaliya onwards, in the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and Kunashir, in Mongolia, northeastern China, Korea and Japan.

80. Chlorophus gracilipes Fald. Widely distributed on Sakhalin in the center and south. More common and plentiful than the other Chlorophorus species found on the island. Flight period in the second half of July and in August. The beetles are found in large numbers on flowers and on fallen Sakhalin fir. Found in spruce and fir forests. The larvae develop in dead fir trunks (fallen trees, standing deadwood and felled timber). Little economic significance. The area of the species embraces Siberia, the Khabarovsk subdistrict, Sakhalin, Mongolia, Korea, Japan and China.

81. Plectrura (Phylctidola) metallica H. W. Bat. var. sachalinica Jacob. Probably an insular endemic species. The habitat consists of mountain and valley spruce and fir forests containing deciduous as well as coniferous trees. Found in the central and southern districts of Sakhalin. Flight period begins in late June and continues throughout July. Known to exist in Sakhalin and northern and central Japan.

82. Lamia textor L. Tamanuki (1933) ascribes this species to northern Sakhalin. I have not found it, nor is it in the Academy's collections. Known to exist on Sakhalin, in Europe, Siberia and Korea and on the island of Hokkaido.

83. Monochamus urussovi Fisch. Found in large numbers throughout the island. Its phenology is somewhat different in the north and south. Thus in the southern districts (Aniva, Gornozavodsk, Kholmsk) the flight period begins in the first half of July, while in the more northerly districts (Poronaysk, Kirov) it occurs in August. Breeds in large numbers on slash fire sites, on dying plantations and in lumbering areas. Infests fir and spruce to an equal degree. This longicorn beetle has been known to attack healthy trees. Widely distributed in Europe, Siberia, the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and in Korea and Japan.

84. Monochamus saltuaris Gebl. Encountered sporadically (usually single specimens) in the north and center of the island, in spruce and fir forests. Flight period in late July and August. Infests spruce and fir. Found in Eastern Europe, Siberia, the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and the southern islands of the Kuril group, in Korea and Japan.

85. Monochamus impluviatus Motsch. Found in the spruce and larch forests of the northern third of Sakhalin. Rare. Flight period in August, but some specimens have been observed in early September. Known to exist in Siberia, on Sakhalin and in northeastern China.

86. Monochamus sutor L. Found primarily in the northern and central districts of Sakhalin. Its phenology, ecology and potentialities as a pest are similar to those of Monochamus urussovi Fisch., but it is much less frequently encountered and is less plentiful. The area of the species is extensive and embraces Europe, Northern Asia as far as the Pacific, Sakhalin, northeastern China and Mongolia.

87. Monochamus galloprovincialis Oliv. Tamanuki (1933) ascribes this species to Sakhalin, but I have not discovered it and it is extremely doubtful that it exists on the island. It is found in the forests of Eurasia and its southern limit is Soviet Central Asia.

88. Mesosa myops Dalm. Found in central and southern Sakhalin and possibly in the north, wherever there are alder trees. Flight period in July and August. The larvae develop on weakened Manchurian alder (Alnus hirsuta) and Alnus maximowiczii. Found in Europe and Siberia, on Sakhalin and in Korea.

89. Mesosa japonica H. W. Bat. Comparatively rare on Sakhalin, where it has been found in the south. I collected it around Cape Lamanon on Alnus maximowiczii. In Japan the beetle is found on chestnut and maple trunks. The flight period is somewhat prolonged and continues from June through August. Found on Sakhalin, in Japan and on Formosa. An insular endemic species.

90. Olenecamptus octopustulatus Motsch. Only one specimen has been collected near Yuzhno-Sakhalinsk. I have not discovered it on the island, but it is known from the palearctic region. Found in the Amur Basin and the Primor'ye, on Sakhalin and in northern Korea.

91. Asaperda agapanthina H. W. Bat. Extremely rare. Tamanuki (1933) collected it near Novo-Aleksandrovsk (South Sakhalin district). I have not found it. Found on southern Sakhalin and in northern Japan. The data for its presence in North Africa are open to doubt.

92. Pogonocherus (Pityphilus) fasciculatus Deg. Found throughout the island, but comparatively rarely. Its habitat is spruce and fir forests, where it infests fine twigs and the crowns of weakened spruces and possibly pines. Flight period in July and August. I have found the beetles crawling on stacked timber but it does not do serious damage on Sakhalin. Tamanuki (1933) states that the subspecies Pogonocherus fasciculatus pulvi Mats. is to be found on Sakhalin and in Japan. Found in the taiga zone in European Russia, in the Caucasus and Siberia, in the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and in Japan.

93. Pogonocherus dimidiatus Bless. Not indicated in the Japanese literature for Sakhalin. I have only found a single specimen in the mountain spruce and fir forests of the Lamanon peninsula. It is apparently extremely rare. Found on Sakahlin, in the Primor'ye, Japan, Korea, and throughout northeastern and central China as far as Formosa.

94. Acanthoderes clavipes Schrank. Rare on Sakhalin. Two specimens have been collected in the south of the island near Novo-Aleksandrovsk in late July and the first half of August. Found in Europe and Siberia, on Sakhalin and in northern Korea and northern Japan.

95. Acanthocinus griseus F. Found in central Sakhalin, in the Uglegorsk and Krasnogorsk districts. Not previously reported from the island. Lives in spruce and fir forests. Flight period in July and August. Found in the north of European Russia, in Siberia and on Sakhalin.

96. Acanthocinus carinulatus Gebl. Fairly plentiful throughout Sakhalin. Its habitat is coniferous forests. Flight period in late July and August. The beetles infest newly fallen trees, standing deadwood and weak trees (Jeddo spruce and Sakhalin fir). Its economic significance is not great. Widely distributed in Europe, the Urals, Siberia, the Khabarovsk subdistrict and the Primor'ye, on Sakhalin and in Japan and northern Korea.

97. Acanthocinus stillatus H. W. Bat. Rare. A few specimens are known from southern Sakhalin. The habitat is spruce and fir forests. Flight period in August. Tamanuki (1933) states that the larvae develop on Jeddo spruce. Found in the Primor'ye, on Sakhalin and in Japan.

98. Agapanthia daurica Gangl. Tamanuki (1933) ascribes this species to southern Sakhalin, but I have not discovered it. It is clearly rare. Found in Eastern Siberia, Dahuria, on Sakhalin, in Japan and in northeastern China and in Korea.

99. Agapanthia villosoviridescens Deg. Found in central and southern districts of Sakhalin. Flight period in July and August. The larvae are found on deciduous trees. The habitat is deciduous and mixed valley forests. Known to exist in the north of European Russia, in the Caucasus and on Sakhalin.

100. Saperda balsamifera Motsch. Rare: Tamanuki (1933) found it in the south, but I have not discovered it. Found in Eastern Siberia, on Sakhalin, in northeastern China and northern Korea.

101. Saperda interrupta Gebl. Found in the south of Sakhalin, where it has been discovered in the Dolinsk, Yuzhno-Sakhalinsk and Korsakov districts. Biology unstudied. Tamanuki (1933) mistakenly took it to be S. laterimaculata Motsch. Found in Eastern Siberia, in the Primor'ye, on Sakhalin and in northeastern China.

102. Saperda octomaculata Bless. Rare on Sakhalin. Tamanuki (1933) ascribes it to the south of the island. I have not discovered it. Known to exist in Eastern Siberia, on Sakhalin and in northeastern China.

103. Eutetrapha metallescens Motsch. Quite common on the island but not plentiful. Found on umbellifer flowers in the center and south. Habitat — deciduous valley forests. Flight period in July and August. Tamanuki (1933) reports that var. chrysargyrea H. W. Bat. is found on Sakhalin and in Japan. Its area embraces Eastern Siberia, Sakhalin, northeastern China and Korea.

104. Eutetrapha variicornis H. W. Bat. I have not found this species, which is clearly extremely rare. Tamanuki (1933) states that it is found in southern Sakhalin — in the Dolinsk and Yuzhno-Sakhalinsk districts. Known from Sakhalin, Japan and northern Korea.

105. Menesia sulphurata Gebl. According to Tamanuki (1933) this species is found in southern Sakhalin. It is extremely rare. Found in Eastern Siberia, on Sakhalin, in northern Japan and in northeastern China.

106. Oberea rufomaculata Kôno et Taman. Described from northern Sakhalin. Tamanuki's mention (1933) of its discovery in Eastern Siberia is open to doubt. I have not discovered it; it is not present in the Academy's collections, nor is it mentioned by other authors.

107. Cagosima sanguinolenta Thoms. Tamanuki's report (1933) of the discovery of this species on Sakhalin is open to doubt. If it is found on the island it must be extremely rare. I have not found it. It is known to exist in northern and central Japan.

108. Glenea relicta Pasc. According to Tamanuki (1933) the species occurs on the west coast of Sakhalin, but I have not discovered it. Tamanuki states that it is found in Eastern Siberia and on Sakhalin.

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PARASITES OF INJURIOUS SCALE INSECTS FROM KABARDIN-BALKARIA (HYMENOPTERA, CHALCIDOIDEA)

B. M. CHUMAKOVA

The source from which the existing collection of biological control agents is supplemented with new local species is the USSR's fauna of parasites of harmful insects; yet there are extensive regions of the country which have still hardly been investigated at all so far as the discovery and recognition of useful insect fauna are concerned. The present paper contains information, collected by the author, on species composition, biology and importance of parasites of the main species of scales and mealy-bugs attacking orchard and forest crops in Kabardin-Balkaria. This is a part of the Northern Caucasus on which the literature contains hardly any information in regard to the question under discussion.

A parasitic fauna of the following species of Coccidae has been discovered: the San Jose scale (Diaspidiotus perniciosus Comst.), the European fruit scale (D. ostreaeformis Curt.), the poplar scale (D. gigas Thiem et Gern.), the oak scale (D. zonatus Frauenf.), the yellow pear scale (D. spurcatus Sign.), the oystershell scale (Lepidosaphes ulmi L.), the willow scale (Chionaspis salicis L.), the rose scale (Aulacaspis rosae Bouche), the spruce scale (Nuculaspis abietis [Schr.]), the pine scale (Leucaspis pusilla Loew), the European fruit lecanium (Parthenolecanium corni L.), the globose scale (Sphaerolecanium prunastri [Fonsc.]), the hawthorn scale (Palaeolecanium bituberculatum [Targ.]), the steppe rose scale (Rhodococcus rosophilus Borchs.), the spruce bud scale (Physokermes piceae Schr.), the European elm scale (Gossyparia spuria Mod.), the apple mealy-bug (Phenacoccus aceris Geoffr.) and the golden oak scale (Asterolecanium variolosum Ratz.).

Systematic collections of Coccidae for the purpose of rearing their parasites have been made in the foothill region of the Republic, at Nal'chik and the surrounding district. For the same purpose surveys of the tree vegetation in the mountainous and steppeland parts of Kabardin-Balkaria and some of the adjacent districts have also been made.

The base for this work, which was done in 1957-1959, was the Kabardin-Balkaria Horticultural Experiment Station. The illustrations accompanying the text are the author's. Descriptions of the parasites are given in the case of new, rare or disputed species.

San Jose Scale (Diaspidiotus perniciosus Comst.)

In this region the pest infests, in addition to fruit trees, the wild loquat, the cherry plum and cork elm, hawthorn and willow shrubs. The main damage is to apple orchards. In some cases, where there has been previous heavy damage to old orchards, the trees are in process of clearing themselves of the pest. The reasons for this are complicated and apparently involve a combination of factors, some of which are biotic. Important among the latter are several species of parasites on which information is given below.

Aphytis proclia Wlk. — The short-fringed Aphytis (Fig.1)

Female. Club slightly more than three times longer than it is wide, fore wings hyaline, thickly pubescent, 10-11 long hairs marginally on marginal vein, fringe short, about 1/8 of the maximum wing width, 10-11 short rows of hairs from base of fore wing to bare oblique band. Mesonotum with 10-12 setae in three rows. Club with a dark spot apically, thorax above infuscate, postphragma infuscate, fore wings with a transverse dark band medially, reaching anterior margin of wing, with the darker portion behind radius, two dark curved bands at wing base, tibiae and tarsi slightly infuscate. Abdomen orange in live specimens, with dark transverse bands laterally, sometimes running all the way across the abdomen. Length 0.9-1.0 mm.

Male. Mesonotum with 10 hairs in 3 rows. Nine to ten long hairs on margin of marginal veing, 7-8 small rows of hairs from wing base to bare oblique band, fringe short, antennae slightly infuscate, club without a dark spot apically, body light yellow, thorax above and abdomen laterally slightly infuscate, abdomen orange. Wings hyaline with a slightly darkened spot behind radius, not reaching the posterior margin of the wing. Length 0.7-0.8 mm.

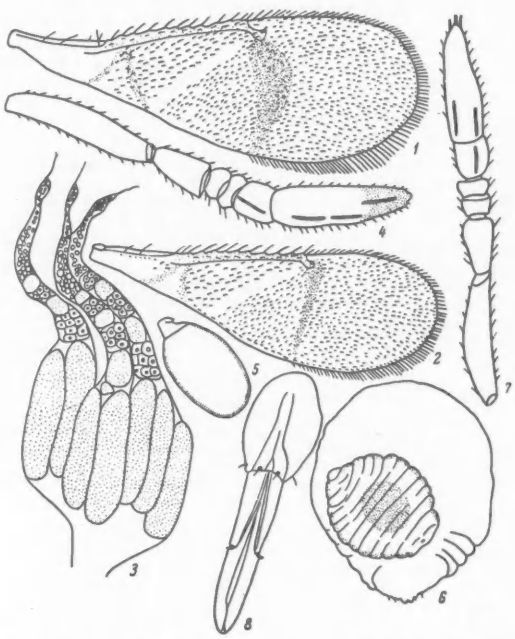

Fig. 1 - Aphytis proclia Wlk. 1 - forewing of female; 2 - forewing of male; 3 - ovary on day of eclosion of female; 4 - female antenna; 5 - deposited egg; 6 - larva of parasite on body of scale; 7 - male antenna; 8 - male genitalia.

The females emerge with several mature eggs in the ovary. The latter consists of 3 paired ovarioles. The mature egg of the parasite in the ovary is large, not hyaline, ovate-oblong, without a petiole; the deposited egg is almost circular. The parasite has been obtained both from specimens of scales collected in the steppe part of Kabardin-

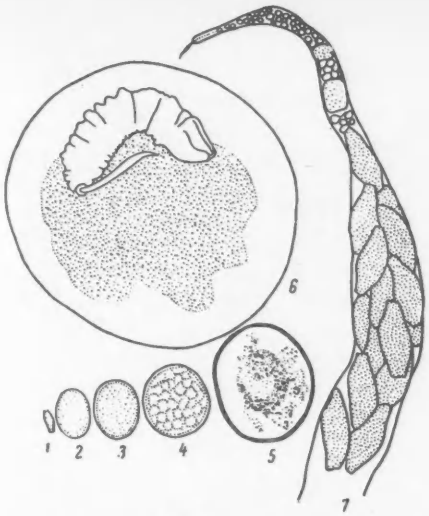

Fig. 2.- Prospaltella perniciosi Tow. 1-5 - eggs of parasite in various degrees of swelling in body of scale; 6 - larva before eclosion; 7 - ovariole on day of eclosion of female.

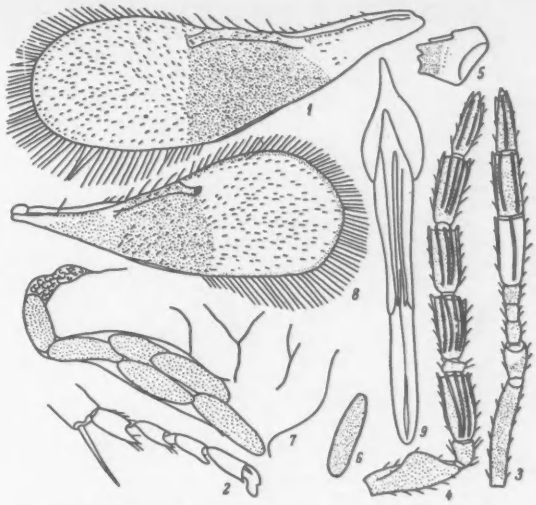

Fig. 3 - Pteroptrix maritima Nik. 1 - forewing of female; 2 - tarsus of middle leg; 3 - female antenna; 4 - male antenna; 5 - mandible; 6 - mature egg in ovary; 7 - ovariole on day of eclosion of female; 8 - male wing; 9 - male genitalia.

Balkaria and the Stavropol'sk area (Prokladnaya, Podkumok, Georgiyevsk, Pyatigorsk) and from the foothill zone (Nal'chik, Cherkesk, Karachayevsk). Here it is the usual parasite of Diaspidiotus perniciosus Comst. Sometimes it has been observed to complete its growth on pronymphs of the male host. In this case the pupa of the parasite is smaller and more elongated than when it develops on the female. The males of A. proclia probably emerge from such pupae. The degree of infestation of the scales varies greatly from year to year and with different host species. According to the 1957 and 1958 records the effectiveness of the parasite in apple orchards where DDT had been systematically applied was 0.4-0.1%, against 29% in orchards not treated with DDT, while in orchards where nectariferous plants had been expressly sown to nourish the parasite, 73% of the first generation females were destroyed.

Under Nal'chik conditions A. proclia develops in four complete generations and a fifth partial one, or two complete generations and a third partial one of Diaspidiotus perniciosus Comst. Its fertility potential is 40-45 eggs, but actual egg deposition depends on the feeding conditions for the adult stage. When fed on nectar the parasite deposits almost all the eggs present in its ovary; without nectar it deposits 1-3 eggs. The sex ratio varies; in spring and at the beginning of summer there are more males, in August and September more females.

Aphytis mytilaspidis Baron. — The polyphagous Aphytis.

Individual specimens have been reared on several occasions from Diaspidiotus perniciosus Comst. The life span of the females is 25 days when fed on nectar and the actual fertility rate 40 eggs. In shape the ovary is similar to that of A. proclia and consists of 6 ovarioles.

Prospaltella perniciosi Tow. (Fig. 2)

Data on this parasite were published not long ago (Chumakova, 1957) but did not include material from Kabardin-Balkaria. P. perniciosi has been found in the area under investigation wherever Diaspidiotus perniciosus Comst. occurs, usually in conjunction with A. proclia. In Nal'chik infestation of DDT-treated orchards amounted, in autumn, to 2.8-2.5% against 42% where DDT had not been used. The life-span of adults fed on nectar was 42 days against 1-2 days when the food was withheld. The female of the parasite has 8 ovarioles in the body, each containing a large number of mature eggs when the insect emerges from the pupa; fertility potential —120-130 eggs. The mature eggs in the ovary are oval, narrowing at the extremities. The deposited egg is very small at first but gradually swells in the body of the scale and becomes quite large. P. perniocosi in our area comes next in importance to A. proclia.

Pteroptrix maritima Nik. (Fig. 3)

Female. Head not wider than long, frons wider than compound eye, genae long, mandibles with tooth and truncation, labial palpi with one segment, maxillary palpi 2-segmented. Antennae 8-segmented, pedicel almost equal in length to the first two funicular segments; first and third funicular

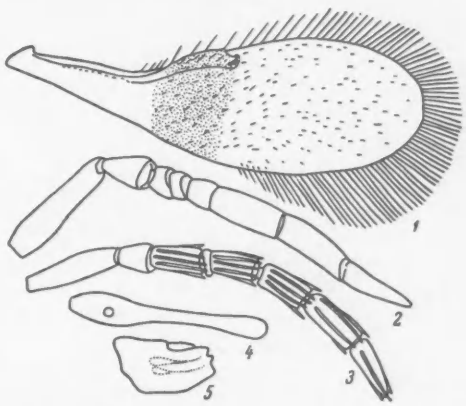

Fig. 4 - Pteroptrix dimidiata Westw. 1 - forewing of female; 2 - female antenna; 3 - male antenna; 4 - mature egg in ovary; 5 - mandible.

segments almost equal in length, second slightly shorter; the funicle equal in length to the first club segment. The club 3-segmented, distinctly wider than the funicle; its first two segments of almost equal length, the third slightly shorter, apically spiculate. Scutellum broadly rounded; wings long, three times longer than wide. Marginal vein not thickened, equal in width to radius, which is fairly long (not less than one third the length of the marginal vein); fringe about one third the wing width. Tarsi 4-segmented, spur of median tibia longer than 1st tarsal segment; abdomen circular,

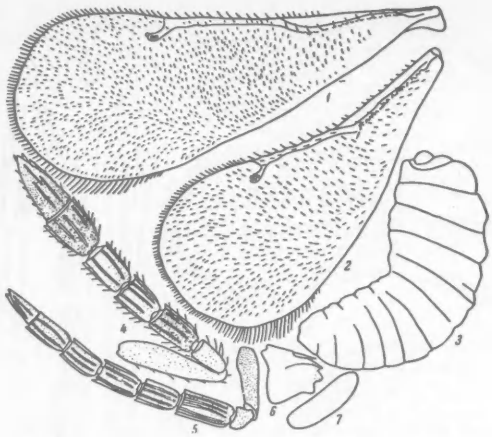

Fig. 5 - Physcus testaceus Masi. 1 - forewing of female; 2 - forewing of male; 3 - larva after feeding has terminated; 4 - female antenna; 5 - male antenna; 6 - mandible; 7 - mature egg in ovary.

shorter than thorax; ovipositor slightly protuberant. Ovary with fewer than 10 ovarioles, matureeggs in ovarywithout petioles. Head light brown, apex of scape and pedicel and 1st club segment yellow, 2nd club segment slightly infuscate, scape, funicle and 3rd club segment infuscate. Thorax dark brown, axillae lighter, scutellum in live individuals blue, wings with infuscation under marginal vein, femora and middle of tibiae black; bases of femora and tibiae, apices of tibiae and tarsi white, abdomen brown with lighter transverse bands; length 0.8 mm.

Male. Similar to female. Scape widened, with apical prominence, pedicel short, circular, about 1/3 the length of the 1st funicular segment, 2nd funicular segment ring-shaped, last club segment acuminate. Phallobase short, fairly broad,

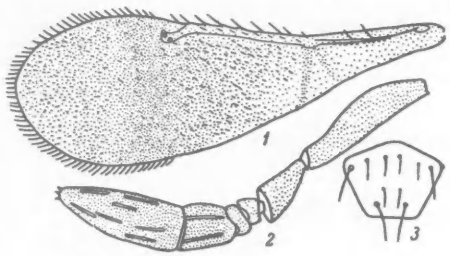

Fig. 6 - Aphytis testaceus Chumakova, sp.n. 1 - forewing of female; 2 - female antenna; 3 - mesonotal setae.

parameres long. Length 0.7 mm.

Pteroptrix maritima differs from other species of this genus in having marginal vein not thickened, fringe shorter, club widened in comparison with the funicle, fewer than 10 ovarioles, mature eggs in the ovary short oval without petioles, and in the males a widened scape and very short phallobase. It is probable that this species will in future be assigned to an independent genus.

Pteroptrix maritima was reared from collections of Diaspidiotus perniciosus Comst. on ozier willows growing on the banks of the river Nal'chik on several occasions in 1958 and 1959 and also from the same species on cork elm in the Nal'chik park and from D. gigas Thiem. et Gern, again in the Nal'chik park.

Pteroptrix dimidiata Westw. (Fig. 4).

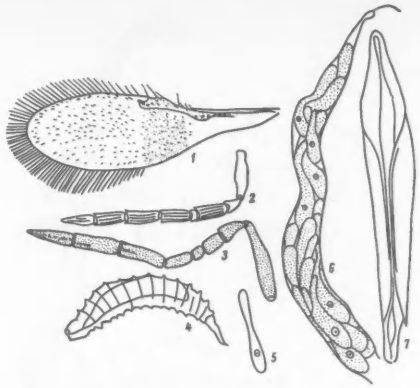

Fig. 7 - Pteroptrix longicornis Nik. 1 - forewing of female; 2 - male antenna; 3 - female antenna; 4 - overwintering larva; 5 - mature egg in ovary; 6 - ovariole on day of eclosion; 7 - male genitalia.

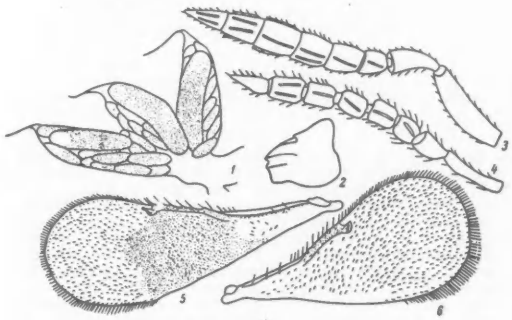

Fig. 8 - Coccophagoides similis Masi. 1 - ovarioles of female on day of eclosion; 2 - mandible; 3 - female antenna; 4 - male antenna; 5 - forewing of female; 6 - forewing of male.

Female. Marginal vein greatly widened, radius short, one-fourth as long as marginal, antennae short, relatively broad, 2nd funicular segment more than half as long as the 3rd, 1st club segment 2 1/2 times longer than wide. Abdomen conical. Body dark brown, axillae, humeri and scutellum yellow.

The ovary consists of 28 ovarioles, containing many mature eggs at the moment of hatching. The mature eggs in the ovary are greatly elongated, hyaline, with wide petioles. Reared from Diaspidiotus perniciosus Comst. collectedfrom hawthorn bushes.

Physcus testaceus Masi (Fig. 5)

Isolated specimens reared from samples collected in the vicinity of Nal'chik on hawthorn bushes. The ovary consists of 6 ovarioles; mature eggs, large, not hyaline, without petioles.

Casca chinensis How. Found on two occasions, two specimens each time, from collections of the pest on willow in Nal'chik. First emergence noted on 26 June.

European Fruit Scale (Diaspidiotus ostreaeformis Curt.)

This scale does no less damage in some of the Kabardin-Balkaria orchards than the San Jose scale. It infests apple trees in large colonies. It also attacks forest trees — birch, wild sweet cherry, aspen and some others.

A complex of parasites has been observed on this scale, reducing its population in spring and summer by 19.5-23.3%; in the fall the extent of parasitization falls slightly to 13.6-

13.7%. The following parasites have been taken from the scale.

Aphytis testaceus Chumakova, sp. n. (Fig. 6)

Female. Head covered with fine light hairs, ocelli in an obtuse-angled triangle, mandibles with 2 teeth and a truncation. Club 3 times longer than 3rd funicular segment, with 6-7 sensillae visible in one plane, 3rd funicular segment with 2 sensillae. Wings covered with dense short hairs, wide, 2 1/2 times longer than wide, fringe short, its greatest length about 1 6 of the wing width. From the base of the wing to the bare oblique band there are 6 short rows of hairs, 7-8 hairs on margin of marginal vein, submarginal vein with 2 hairs of almost equal length. Cerci with two long hairs and one short one. Body yellow with uniform smoky infuscation of all the body segments, the wings, the antennae and the legs. Club without a black spot apically. Wings from base to middle more intensively infuscate. At base of wing a dark curved band. Abdomen in live specimens with slightly darkened transverse bands. Length 1.1-1.0 mm.

Male. Not known.

Karbadin-Balkaria ASSR, Starry Cherek, orchard of Sovetskaya Armiya collective farm, apple trees (Malus), from females of the European fruit scale Diaspidiotus ostreaeformis Curt., on 12 and 13 June 1957, 3 ♀♀; 30 May 1959, 2 ♀♀ (B. Chumakova). The holotype (♀) in the form of a total mount and the paratype (1 ♀) in the form of a total mount are kept in the Institute of Zoology, USSR Academy of Sciences, and the remaining specimens in the collection of the biomethod laboratory of the All Union Institute of Plant Protection.

The life cycle of the parasite coincides closely with the growth cycle of the host. It is parasitic on the females of the pest. A testaceus, sp. n. overwinters, as a diapausing last-instar larva, under the double cover of the scale and the body of a dead female. The adult individuals emerge at the end of May and the beginning of June, during the season when the sexually mature females of the host appear. A. testaceous develops, exactly as the host, in one generation, and enters into diapause at the end of July, at the time when the female scales die off, having by then finished production of the crawlers. The diapausing larvae of the parasite, as compared with last-instar larvae, which have only just finished feeding, lose something of their turgescence, shrink somewhat and become slightly smaller. Both the growth and the diapause of A. testaceus are thus synchronized with those of the pest—an indication of specificity. The reduced degree of infestation of the pest by the parasite towards fall seems to be due to the early cessation of activity on the part of A. testaceus.

Aphytis mytilaspidis Baron.

Several specimens reared at the same time as the preceding species, from which it differs in developing on Diaspidiotus ostreaeformis Curt. in the second half of summer as well and on young females which have been left to overwinter.

Pteroptrix longicornis Nik. (Fig. 7)

This is the usual parasite of Diaspidiotus ostreaeformis Curt. It overwinters in the young larval stage inside overwintering individuals of the host. Its females are hatched with large quantities of mature eggs in the ovaries. There are 15-16 ovarioles in each ovary. The mature eggs in the ovary are long, with broad petioles. The degree of infestation of the host by this parasite in fall is 13-14%.

Coccophagoides similis Masi (Fig. 8).

Reared from collections of Diaspidiotus ostreaeformis Curt. on the bank of Nal'chik River (Dolinsk). Emergence of parasite noted on 22 July. Ovary consists of 6 sac-like ovarioles. The females have one mature egg in each of these tubes at the moment of hatching, together with a number of smaller immature oocytes. The mature egg in the ovary occupies almost the entire length of the tube and is oval, opaque and without petiole. D. ostreaeformis Comst. seems to be the main host of this parasite.

Prospaltella gigas Chum.

Emerged in small quantities from collections of scales from apple tree in Staryy Cherek.

The Poplar Scale (Diaspidiotus gigas Thiem et Gern.)

There are eight species of chalcids parasitic on this scale. In spring and early summer infestation of individuals which have overwintered is 48.9-54.5%, falling once the summer hatching starts, to 15.5-15.9%, in June. The number of parasitized individuals then again increases, to reach 34.1-41.2% in early July, remaining at approximately this level until the pest enters hibernation. The parasites are listed below.

Coccidencyrtus (?) dissimilis Chumakova, sp. n. (Fig. 9)

Female. Head transverse, wider than thorax, genae long, frons broad but narrower than transverse diameter of eyes, ocelli in an equilateral triangle, occiput without a sharp margin, mandibles clearly tridentate, maxillary palpi 4-segmented, labial palpi 3-segmented. Antennae attached somewhat below lower margin of eyes, scape and pedicel cylindrical, the latter being 1/3 the length of the former, first 4 funicular segments clearly longer than wide, 5th almost quadrate, 6th transverse. Club oval, wider than funicle, apically acuminate, equal in length to the last 3 funicular segments combined. Pronotum short, mesonotum transverse, longer than scutellum, scutellum almost as long as it iw wide, hairy, with two longer white hairs apically, axillae 2/5 the width of the scutellum, their apices adjoining. Wings hyaline, densely hairy. Marginal vein distinct, longer than wide, radius long, postmarginal almost equal to radius. Abdomen broad, cordate, shorter than thorax, ovipositor slightly protruding. Head and thorax with fine reticular sculpturing. Body black with a metallic glint, antennae dark brown, the 2 last funicular segments white, palpi white, fore and hind legs black, knees and apices of tibiae and tarsi yellow, middle tibiae yellow up to the middle. Length 1.1-1.23 mm.

Male similar to female. Antennae cylindrical with whorls of long hairs, wings shorter and wider than in female, scape and pedicel dark brown, funicle and club brown. Length 0.9 mm.

Nal'chik, poplar (Populus), poplar scale Diaspidiotus gigas Thiem et Gern., 18 June 1957, 2 ♀♀, 1 ♂ (including holotype); 10 June 1957, 4 ♀♀; 8 July 1957, 8 ♀♀, 3 ♂♂ (including allotype); 14 June-22 June 1958, 6 ♀♀, 1 ♂. Nal'chik, Dolinsk, willow, poplar scale, 24 June 1958, 2 ♀♀. Kislovodsk, poplar, poplar scale, 20 July 1959, 3 ♀♀. Karachayevsk, poplar, poplar scale, 3 July 1957, 2 ♀♀ (B. Chumakova). Holotype, allotype, 2 male paratypes and 3 females in Institute of Zoology (USSR Academy of Sciences) collections, remaining specimens in biomethods laboratory of the All Union Institute of Plant Protection.

The newly described species differs from Coccidencyrtus pinicola Merc. in the size of the funicle and the coloration of its fifth segment. In C. dissimilis, sp. n., the first 4 funicular segments are longer than wide, the 5th almost quadrate, the 6th wider than long and the last two segments white. In C. pinicola only the 6th (last) funicular segment is white, and all the funicular segments are slightly transverse.

Coccidencyrtus (?) dissimilis, sp. n., infests the female scales, one parasite developing on each scale. During the feeding period the larva is fat, white, scimitar-shaped, with a black tail formed from the remains of the egg. Respiration is through a trachea, the end of which emerges externally. When the larva has finished feeding it loses color, retracts the cauda and becomes entirely white. Even after the parasite has emerged it is possible to tell that it has been developing in the cuticula of the scale from the black skins left behind in the empty cuticula. The parasite emerges with dumb-bell shaped mature eggs in the ovary. The ovary consists of 3 pairs of ovarioles. The cover of the female scale, in which the development of C. gigas is completed, bulges heavily in the middle and has collapsed margins. The parasite emerges from 8 June to 28 July.

Euaphycus duplus Chumakova, sp. n. (Fig. 10)

Female. Head slightly wider than thorax, ocelli in an acute-angled triangle, genae equal to transverse diameter of eyes, antennal sockets situated slightly above the oral margin. Antennae not unicolorous, scape cylindrical, dilated above

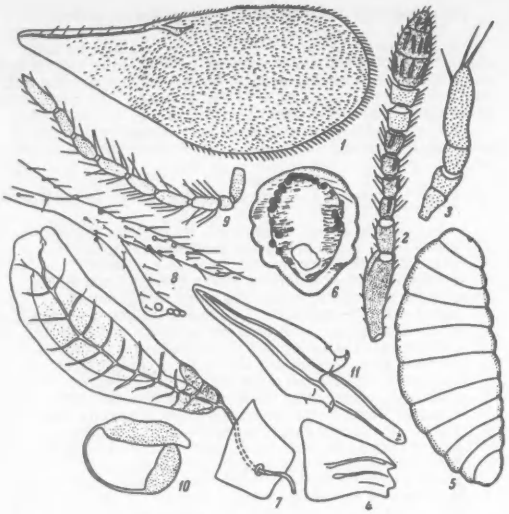

Fig. 9 - Coccidencyrtus (?) dissimilis Chumakova, sp.n. 1 - forewing of female; 2 - female antenna; 3 - maxillary palpus; 4 - mandible; 5 - larva after feeding; 6 - emergence aperture of parasite; 7 - larva when feeding; 8 - vein; 9 - male antenna; 10 - mature egg in ovary; 11 - male genitalia.

the middle, more than 3 times longer than wide, the first 3 funicular segments almost quadrate, the remainder wider than long, the 6th slightly more than 1/2 as long as wide, club dilated, almost equal in length to the last 4 funicular segments combined. Parapsidal furrows poorly visible, intermediate segment wide, abdomen shorter than thorax, spur of middle tibia barely longer than 1st segment of middle tarsus. Marginal vein punctiform, postmarginal not developed, radius fairly long. External plates of ovipositor slightly less than 3 times as long as wide. Body yellow, completely infuscate above. Pronotum black with white spots laterally, mesonotum dark brown, wings transparent with a slightly darkened patch on radial vein; abdomen yellow apically, dark brown basally, middle and hind tibiae with brown bands, bases of middle tibiae and hind femora infuscate. Antennae yellowish-white, middle of scape, base of pedicel and first 4 funicular segments brown, 5th and 6th segments yellow, club black, apically lighter. Length 1.07 mm.

Male. Similar to female, ocelli in an equilateral triangle, scape shorter than in female, twice as long as pedicel, equal in length to the first 3 funicular segments. Body yellow, infuscate above, antennae unicolorous, light brown, club unsegmented, legs white. Length 0.83 mm.

Nal'chik, poplar (Populus), from females of Diaspidiotus gigas Thiem et Gern., 8 July 1957, 4 ♀♀, 1 ♂ (including holotype ♀ and allotype ♂); 24-30 July 1957, 5 ♀♀, 3♂♂; 17-20 June 1958. 1 ♀; 19 July 1958, 3 ♀♀, 2 ♂♂; 15 June 1959, 2 ♀♀, 2 ♂♂ (B. Chumakova). Type preserved in Institute of Zoology (USSR Academy of Sciences), remaining specimen in biomethods laboratory of the All Union Institute of Plant Protection.

The species described is distinguished from the similar species Euaphycus salicis (Erd.) by the longer and narrower scape and the less transverse 6th funicular segment:

Euaphycus salicis Erd.	Euaphycus duplus Chumakova, sp. n.
1. Scape slightly less than 3 times longer than it is wide.	1. Scape almost 4 times longer than wide.
2. 6th funicular segment twice as wide as long.	2. 6th funicular segment almost as long as wide or slightly longer.

Two parasite larvae usually develop in the body of one

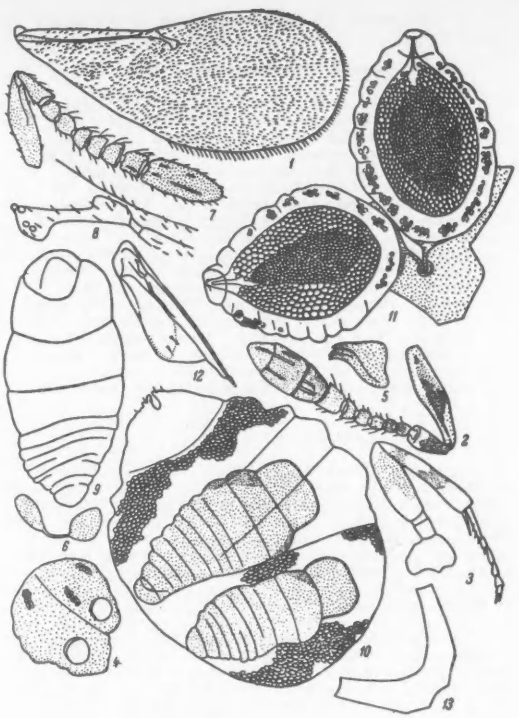

Fig. 10 - Euaphycus duplus Chumakova, sp.n. 1 - forewing of female; 2 - female antenna; 3 - middle leg; 4 - emergence aperture of parasites; 5 - mandible; 6 - mature egg in ovary; 7 - male antenna; 8 - vein; 9 - late instar larva; 10 - pronymphs in body of scale; 11 - young larvae; 12 - external and internal plates of ovipositor; 13 - 9th syntergite of female abdomen.

adult female scale. More rarely, young smaller females of the pest are parasitized by one individual E. duplus. In cases of joint parasitization the tracheae of both larvae emerge externally through a common channel; the 2 larvae are therefore always mounted together. The young larvae of E. duplus are almost circular, the body lengthening as feeding and growth progress. Each larva pupates in a separate enclosed chamber when it has finished feeding. One of these chambers is larger than the other. The female emerges from the larger chamber, the male issuing from the smaller one day earlier than the female. Each individual makes its own emergence aperture. The presence of two emergence apertures in the empty chorion of the scale indicates the previous development of individuals of E. duplus. The females of the parasite emerge with mature ovaries; there are 3 pairs of ovarioles, and the mature egg in the ovary has a short petiole with a distal dilatation. Emergence noted from 2 June to 24 June.

Hispaniella lauri Merc. (Fig. 11).

Develops in scale larvae. Females emerge with mature ovaries; 5-6 ovarioles in each ovary. Mature egg in ovary oval, with a slender petiole. Young larva circular with narrow prolate anterior extremity. Emergence lasts about two months, from the beginning of June to the beginning of August.

Prospatella gigas Chum., reared several times in appreciable quantity. Emergence recorded from 3 to 28 July.

Pteroptrix longicornis Nik. Habitual and abundant parasite of the poplar scale. Emergence noted from 31 May to 22 July.

Signiphorina subaenea (Först.) (Fig. 12)

Female. Head transverse, mandible bidentate, maxillary palpi with 2 segments, labial palpi with 1

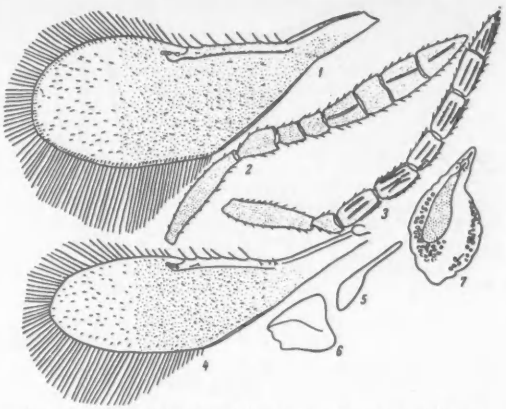

Fig. 11 - Hispaniella lauri Merc. 1 - forewing of female; 2 - female antenna; 3 - male antenna; 4 - forewing of male; 5 - mature eggs in ovary; 6 - mandible; 7 - young larva.

segment. Antennae with 4 ring-shaped segments, club less than 1 2 as long again as scape. Body short and broad, pronotum about 1.5-1.6 the length of the mesonotum. The latter without parapsidal furrows; axillae very small. Scutellum short, transverse. Wings shorter than body, marginal vein long, narrow, radius short, cone shaped, postmarginal not developed. Fringe about 1 3 the width of the wing, middle tibia with two long and one short spines, spur shorter than first segment of middle tarsus, and with 5-6 teeth. Body black, wings under marginal vein distinctly infuscate with a circular white spot at wing base, apex of wing slightly infuscate. Length 0.81 mm.

The specimen of Signiphorina subaenea Först (=S. mala

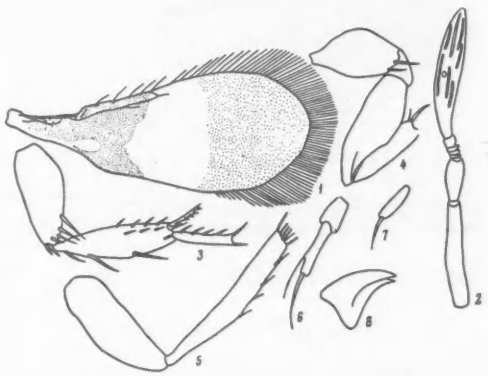

Fig. 12 - Signiphorina subaenea Först. 1 - forewing of female; 2 - female antenna; 3 - middle leg; 4 - foreleg; 5 - hind leg; 6 -7 - maxilliary and labial palpi; 8 - mandible.

Nik.) reared by us differs from those described by Nikol'skaya (1950) in having a shorter mesonotum, a different number of teeth on the middle tibial spur and a shorter antennal club. S. subaenea was reared at Nal'chik from a poplar scale parasitized by Coccidencyrtus dissimilis, sp. n., and Euaphycus duplus sp. n., 2 specimens in all. Emergence on 22 July 1957.

Thysanus ater Wlk. Reared from poplar scale infested by two of the above-mentioned parasites. Emergence noted in the second half of summer.

Azotus matritensis Merc. Several specimens reared in the second half of summer from a collection of scales on a poplar at Nal'chik.

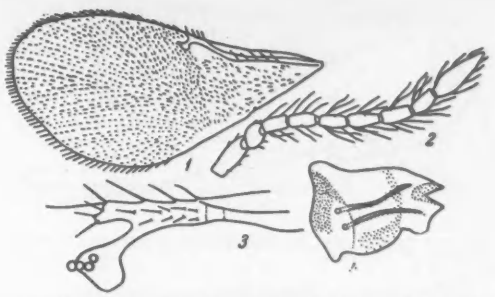

Fig. 13 - Apterencyrtus microphagus Mayr, male. 1 - forewing; 2 - antenna; 3 - vein; 4 - mandible.

Oystershell Scale (Lepidosaphes ulmi L.)

In a number of orchards in the Republic this scale attacks apple trees, frequently in combination with the San Jose and European fruit scales. Of all the harmful species of Coccidae detected here, L. ulmi occurs at the greatest altitudes in the mountains. We found it in the Teberdinsk park at a height of 1,400 m above sea level, in an apple orchard. There were no emergence apertures of parasites. Four species of chalcids were taken from this scale at Nal'chik. All were parasitic on females. The degree of infestation was not more than 3-5%.

Physcus testaceus Masi. Emerged from test specimens

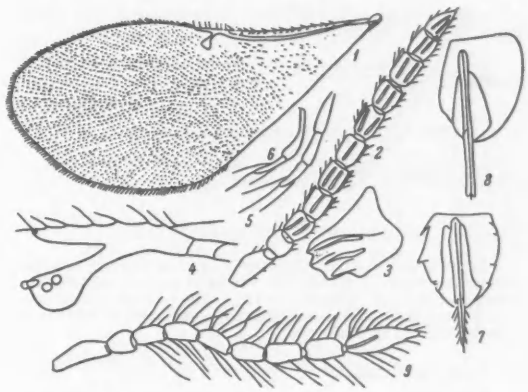

Fig. 14 - Heterencyrtus sumavicus Hffr., female. 1 - forewing; 2 - antenna; 3 - mandible; 4 - vein; 5 - 6 - maxillary and labial palpi; 7 - ovipositor; 8 - ovipositor of Euussuria pallipes Chumakova; 9 - antenna of H. sumavicus Hffr., male.

collected on poplar. Emergence on 8 June 1958.

Aphytis mytilaspidis Baron. Emerged 12 June 1957, 17 May 1958, 14 July 1959.

Anabrolepis zetterstedti Westw. Reared from scale specimens collected on poplar, aspen, sea-buckthorn at Nal'chik and Dolinsk on 10 June 1957 and 14 August 1959.

Apterencyrtus microphagus (Mayr) (Fig. 13). Adult specimens obtained from scale tests on poplar at Nal'chik 10-14 June 1959. The male of this parasite, rarely found in specimens, is described below.

Male. Mandibles with one tooth and truncation, scutellum without tuft of hairs apically, wings wide, marginal vein short, postmarginal not longer than marginal, radius short, apically dilated, equal in length to marginal and postmarginal combined, antennae cylindrical with whorls of long hairs, funicular segments considerably longer than wide, club unsegmented, elongate. Body black, legs black, antennae brown. Length 1.2-1.3 mm.

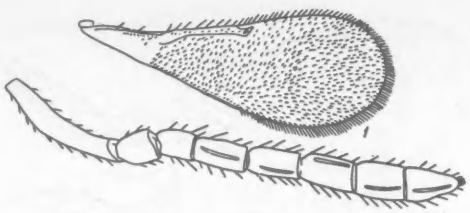

Fig. 15 - Prospaltella aspidioticola Merc., female; 1 - forewing; 2 - antenna.

Yellow Pear Scale (Diaspidiotus spurcatus Sign.)

Seven species of parasitic insects were reared.

Pteroptrix longicornis Wlk. emerged from scales collected on apple tree at Podkumka, emergence 22 July 1958.

Pt. dimidiata Westw. Emergence 10 July 1958, 15-20 July 1959 from collections on apple and pear trees at Podkumka. This scale yielded the largest quantity of the parasite in question found by us and may be the principal host of Pt. dimidiata. From other host species it has invariably emerged singly.

Hispaniella lauri Merc. Emergence 15 July 1958. From collections made in the same place.

Pteroptrix maritima Nik. Emergence 27 July 1958 from apple tree at Podkumka.

Coccophagoides similis Masi. Emergence 23 July 1958 from the same collections.

Aphytis mytilaspidis Baron. Emergence 22 June 1958, Podkumka, plum.

Oak Scale (Diaspidiotus zonatus Frauenf.)

Aphytis mytilaspidis Baron. Emergence 10 June 1957. In specimens from collection at Nal'chik.

Willow Scale (Chionaspis salicis L.)

Seven species of parasites occur on this host but have no great economic importance, the extent of parasitism by the entire complex not exceeding 8-12%. The following parasites were reared from collections of scales gathered at Podkumka from willow and at Kislovodsk from ash:

Aphytis mytilaspidis Baron, emergence 7 July 1958;

Pteroptrix dimidiata Westw., emergence 10 July 1958;

Pt. longicornis Wlk., 8 July 1958;

Coccophagoides similis Masi, 7 July 1958;

Aphytis proclia Wlk., emergence 7-10 July 1958;

Apterencyrtus microphagus Mayr, emergence 7 July 1958.

Heterencyrtus sumavicus Hffr. (Fig. 14). This species has been described, without illustration, by Hoffer (1953) from Dzechoslovakia, from the scale Chionaspis salicis L. on poplar. A second description by Erdös (1956) under the name Kozstarabia chionaspidis Erd. is based on one specimen reared by Erdös from the same scale on ash in Hungary; an illustration of the parasite is given. Later, Hoffer established the identity of the two, on verifying specimens sent him by Erdös. Heqvist (1958) in Sweden described a new species of parasite, Thomsonisca salicis Heqvist, from Chionaspis salicis L. The illustration and description indicate that this is the same as the species described by Hoffer as H. sumavicus and is possibly a synonym. Ferriere (1955) identifies this species as Thomsonisca typica Merc. Specimens of the insect were obtained by us from a collection of willow scale on ash (Fraxinus sp.) in a Kislovodsk park; emergence on 7 July 1958; and on willow in Podkumka, emergence on 23 June 1959. The principal difference between Heterencyrtus sumavicus Hffr. and the parasite reared by us

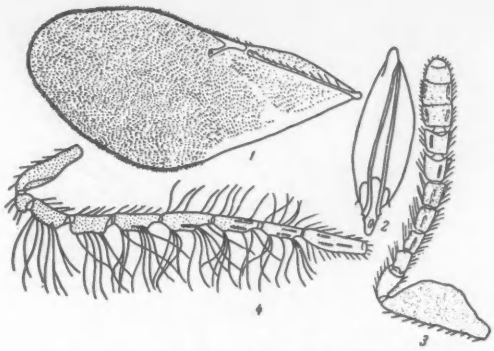

Fig. 16 - Blastotrix ilicicola Merc. 1 - forewing of female; 2 - male genitalia; 3 - female antenna; 4 - male antenna.

from the San Jose scale in the Primorskiy region, Euussuria pallipes Chumakova, is that in E. pallipes the ovipositor is not hairy but bare, whereas in H. sumavicus it is thickly covered with coarse hairs (Fig. 14, 7, 8).

Spruce Scale (Nuculaspis abietis Schr.)

Prospaltella aspidioticola Merc. (Fig. 15). This parasite is little known in our fauna. Its description is given below.

Female. Length 0.7 mm. 1st funicular segment almost equal to pedicel, 2nd barely longer than 3rd, club clearly demarcated from funicle, 3rd club segment shorter than 2nd, wings without infuscation, fringe short. Thorax completely yellow, pronotum, sides of mesonotum and intermediate segment infuscate, abdomen black with

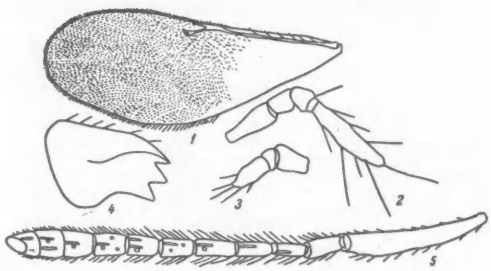

Fig. 17 - Trichomasthus albimanus Thoms., female. 1 - forewing; 2 - 3 - maxillary and labial palpi; 4 - mandible; 5 - antenna.

darker apex and base.

Extracted in August 1959.

Pine Scale (Leucaspis pusilla Loew.)

Prospaltella leucaspidis Merc. On pine, Nal'chik, 16 August 1959.

Azotus sp. Primary parasite of scale, emergence 13 August 1959.

Rose Scale (Aulacaspis rosae Bche)

In the area under study this scale mainly infests the wild rose, without forming large colonies. The usual species parasitic on this pest were taken from it: Adelencyrtus aulacaspidis (Breth.), Arrenophagus chionaspidis Auriv. and Aphytis proclia (Wlk.). The extent of parasitism by natural enemies is high, and in June exceeded 55% according to our calculations.

European Fruit Lecanium (Parthenolecanium corni L.)

In Kabardin-Balkaria this pest does serious damage to plum and to a smaller extent apple orchards. Timber plantations which suffer heavily from it include ash, honey locust, white acacia, wild medlar and hawthorn; in mountain forests (the Cherek and Chegem gorges) it attacks hazel. In three years of observing regular collections adult female parasites of the pest were discovered only once, in 1959. Before then only isolated males had been reared and we found no emergence apertures on the scale. None of the parasites reared from the host here plays any essential part in reducing the host population; infestation is always by a single individual.

Coccophagus lycimnia Wlk. The usual parasite of the larvae of many Coccidae. In our case it was reared from collections of the Coccidae found at Nal'chik on ash, honey locust, wild medlar and lime; in the Cherek and Chegem gorges on hazel and willow; at Kislovodsk and Zolotushka on ash. Emergence 17 June 1957, 15 June 1958, 20 July 1959.

Metaphycus insidiosus Merc. Emergence recorded from 12 June to 20 July 1957 and 20 July 1959.

Microterys sylvius Dalm. Emergence 3 July 1959 from collections of the pest on honey locust at Nal'chik.

Microterys sp. Possibly a new species. Emerged on 3rd July 1959 from collections in Chegem gorge on willow on the bank of the Chegem River.

Blastotrix ilicicola Merc. (Fig. 16). Females appeared on 22 June, and emergence continued to 7 July 1959, from collections of mealy bugs on willow in Chegem gorge and on honey locust at Nal'chik.

Trichomasthus albimanus Thoms. (Fig. 17). Emergence 15 June 1959. From female mealy bugs on honey locust at Nal'chik.

Hawthorn Scale (Palaeolecanium bituberculatum Targ.)

Occurs in the Republic in small quantities on apple, wild medlar and hawthorn. Does considerable damage to apple trees in orchards inthe Yessentuki and Pyatigorsk districts. Parasites not found on adult females of the pest. Coccophagus lycimnia Wlk. (collections of V. V. Smol'yannikov) reared in small quantities from larvae.

Globose Scale (Sphaerolecanium prunastri [Fonsc.])

The pest was detected at Nal'chik on cherry plum on a bank of the Nal'chik River. It has been found on this tree in the Pyatigorsk, Zheleznovodsk and Yessentuki area. The extent of parasitism on the female pest is high, and reached 64-82% in June 1959. A complex of 6 species of chalcids is parasitic on this mealy bug, including 2 secondary parasites.

Coccophagus lycimnia Wlk. Emergence from 9th May to 30 June 1959.

Discodes aeneus (Dalm.). Emergence from 11 to 30 June 1959.

Microterys hortulanus Erd. (Fig. 18). Emergence from 22 June to 30 June 1959.

Metaphycus sp. Emergence from 26 to 30 June.

Cerapterocerus mirabilis Westw. — secondary parasite; emergence started on 22 June 1959.

Pachyneuron coccorum (L.) — secondary parasite; emergence from 26 to 30 June.

Spruce Bud Scale (Physokermes piceae Schr.)

This pest is very abundant on spruce in Nal'chik (Dodinsk) and Zatish'ye. The population of the kermes is kept down by parasites. On June 1, 1959 the extent of parasitism was 55%. Parasites on this pest are:

Coccophagus lycimnia Wlk. On the larvae; extent of parasitism very slight.

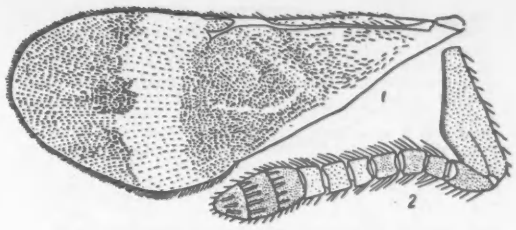

Fig. 18 - Microterys hortulanus Erd. female. 1 - forewing; 2 - antenna.

Aphycoides clavellatus (Dalm.) (Fig. 19). This is the principal parasite of this pest, developing on the females, sometimes more than 10 individuals to one of the mealy bugs. Emergence 26 June 1959, 8 July 1959.

Pseudorhopus testaceus (Ratz.) (Fig. 20). Taken at the same time as A. clavellatus (Dalm.); occurs more rarely than the latter.

Steppe Rose Mealy Bug (Rhodococcus rosophilus Borchs.)

This mealy bug (determination by N. S. Borkhsennius) was first found in the Caucasus. It is known in the USSR from the Krasnoyarsk area and the province of Western Kazakhstan (Borkhsennius 1957). We found it on rose bushes at Nal'chik, (Dolinsk) on the banks of the Nal'chik

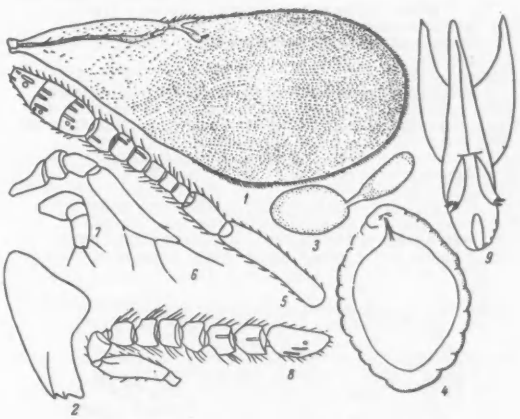

Fig. 19 - Aphycoides clavellatus (Dalm.). 1 - forewing of female; 2 - mandible; 3 - mature egg in ovary; 4 - larva; 5 - female antenna; 6 - 7 - maxillary and labial palpi; 8 - male antenna; 9 - male genitalia.

River. One species of parasite was reared, the extent of parasitism exceeding 75%.

Microterys sp. (Fig. 21). Possibly a new species. Emergence from 28 June to 20 July 1959 simultaneously with the beginning of emergence of the host.

European Elm Scale (Gossyparia spuria Mod.)

This scale does great damage to cork elm in forests, parks and windbelt plantations in Kabardin-Balkaria and the Stavropol'sk area. Three species of parasites attack it.

Coccophagus gossypariae Gah. (Fig. 22).

Female. Antennae dark brown, first funicular segment longer than the other 2, which are almost equal to each other. Marginal vein longer than submarginal, radius short, postmarginal wanting, fringe short, body black, scutellum black with a

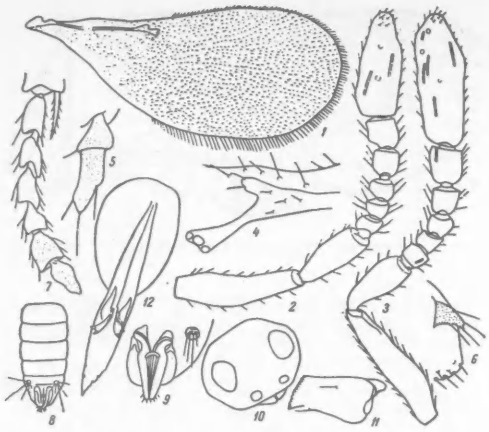

Fig. 20 - Pseudorhopus testaceus (Ratz.). 1 - forewing of female; 2 - male antenna; 3 - female antenna; 4 - vein; 5 - 6 - maxillary and labial palpi; 7 - tarsus of middle leg; 8 - female abdomen; 9 - ovipositor; 10 - head of male; ventrally; 11 - mandible; 12 - male genitalia.

small number of hairs, head black with yellow marbling. Legs white, hind femora and coxae black. Length 1.21 mm.

Male. Differs from female in color of frons, which is completely yellow, and in having a large number of sensillae on the antennae, arranged in two rows.

Emergence recorded from 3 June to 30 July. Reared from collection of the host at Nal'chik and Georgiyevsk on cork elm. Extent of parasitism at the beginning of June was 60%.

Apterencyrtus eriococci Ferr. (Fig. 23).

Female. Head circular, eyes large, frons narrow, ocelli in an acute-angled triangle. Mandibles with 2 teeth and truncation, maxillary palpi 4-segmented, labial palpi 3-segmented. Antennal sockets

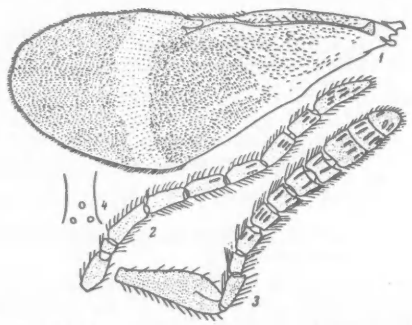

Fig. 21 - Microterys sp. from steppe rose scale. 1 - forewing of female; 2 - male antenna; 3 - female antenna; 4 - arrangement of ocelli on female frons.

not near oral margin. Antennae not unicolorous, scape cylindrical, slightly thickened medially, pedicel more than 3 times longer than 1st funicular segment, first 3 funicular segments small, almost quadrate, the next 2 slightly wider, the 6th and last very long and wide. Club large, greatly dilated, with an oblique excision apically, 3-segmented, equal in length to the whole funicle. Wings large, colorless, marginal vein 3 times longer than wide, postmarginal short, radius equal to postmarginal. Pronotum short,

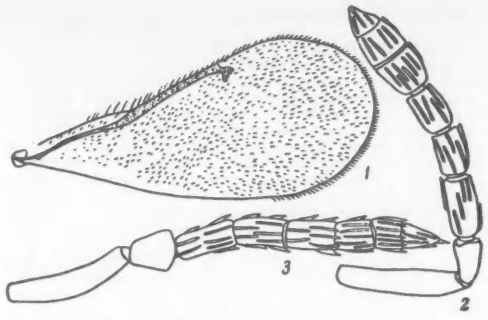

Fig. 22 - Coccophagus gossypariae Gahan. 1 - forewing of female; 2 - female antenna; 3 - male antenna.

scutellum transverse, almost equal to or longer than mesonotum. Tuft of hairs on scutellum not distinct, 2 long hairs terminally on scutellum, spur of middle tibia equal to 1st segment of middle tarsus, which is equal to the 3 last segments taken together; base of ovipositor reaching 1st abdominal segment, external plates of ovipositor almost 5 times longer than wide. Body black with a green sheen, antennae dark brown, apex of scape and pedicel and last 2 funicular segments white, club black, legs black, apices of tibiae and tarsi white, middle of tibiae yellow. Wing tegulae black, base of mandible dark brown, apex red brown, vein light brown. Length 1.21 mm.

Male. Thorax shorter than abdomen, antennae without distinct sensillae, funicular segments cylindrical, considerably longer than wide, con-

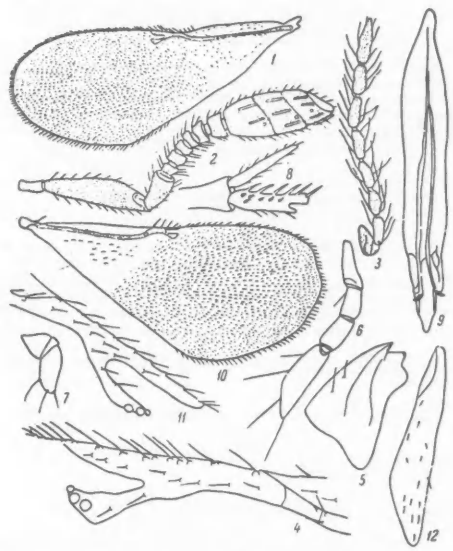

Fig. 23 - Apterencyrtus eriococci (Ferr.). 1 - forewing of female; 2 - female antenna; 3 - male antenna; 4 - vein; 5 - mandible; 6 - 7 - maxillary and labial palpi; 8 - spur of middle tibia; 9 - male genitalia; 10 - male wing; 11 - male vein; 12 - external plate of ovipositor.

stricted at the extremities, the first 2 segments shorter than the last 2, which are almost equal. Club longer than last funicular segment, apically accuminate. Wings wider than in female, twice as long as they are wide. Body black, fore and middle legs light brown, hind legs black, knees and apices of tibiae. Antennae light brown. Length 0.9-1.1 mm.

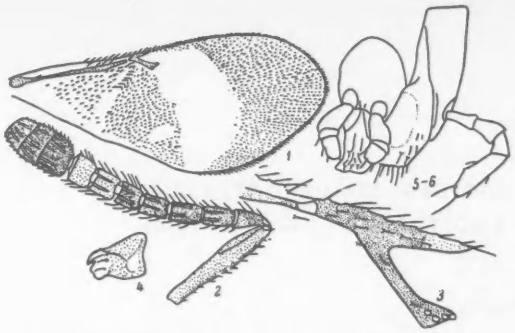

Fig. 24 - Coccidoxenus sp., female. 1 - forewing; 2 - antenna; 3 - vein; 4 - mandible; 5 - 6 - maxillary and labial palpi.

Nal'chik, hornbeam (Carpinus) from the European elm scale, Gossyparia spuria Mod., 24 July 1957, 2 August 1957, 17 August 1957, 30 May 1959, 23 June 1959, 14 August 1959.

Species first described by Ferriere (1955) from Eriococcus salicis Sign.

Coccidoxenus sp. (Fig. 24).

One specimen reared on 30 July 1957 from collection of mealy bugs at Nal'chik on cork elm in park.

All known species of the genus Coccidoxenus come from Africa or South America (Brazil), the African and Brazilian species differing greatly. They are all parasites of mealy bugs; 2 species of this genus, described by Mercet from Europe are known only from the males (Compere, 1937). The specimen reared by us from the European elm scale, to judge from the illustration of Coccidoxenus niloticus Comp., Kenya (Compere 1940), actually belongs to this genus. It has not been possible to clear up its specific taxonomy from the single example, which is in the form of a dismembered mount.

Apple Mealy Bug (Phenacoccus aceris [Geoffr.])

The mealy bug attacks the horse-chestnut, wild sweet cherry and hawthorn. Two species of parasite were nurtured from it.

Aphycus apicalis (Dalm.). Emergence 15 June 1957.

Anagyrus schoenherri (Westw.). Emergence 20 June 1958.

Golden Oak Scale (Asterolecanium variolosum Ratz.)

Two species of Encyrtidae reared; extent of parasitism 2-5%.

Habrolepis dalmani (Westw.). Emergence 16 May 1958 and 2 July 1958 from collections of the mealy bug on oak in the Nal'chik town park.

Euaphycus asterloecanii Merc. Emergence 14 June 1958 from collections on oak in the same place.

The above information on parasites of harmful Coccidae in Karbadin-Balkaria is not exhaustive. The first data obtained, however, indicate that the parasite fauna of this area has marked peculiarities. Of the 46 species of parasites reared, 18 are harmful to species of coccids infesting the area and 3 are new species; in addition, 2 species of Microterys are apparently also new. On comparison of the parasite fauna of these species of Coccidae known to us from the Black Sea littoral of the RSFSR (southern slope of the Caucasus) a marked difference was noticed in the fauna of the latter area both as regards the population of the different species and also as regards their actual presence. In Nal'chik and adjacent regions, for example, the parasites Microterys sylvius Dalm. and Blastotrix ilicicola (Dalm.) play a very small part in controlling the acacia scale, but are most important in reducing the population of this pest on the coast. The small population of these parasites in the Kabardin-Balkaria orchards seems to explain the abundance of the scale there. The secondary parasite Cheiloneurus claviger Thoms. was not found at all here.

The polyphagus parasite most frequently encountered in the subtropics, Aspidiotiphagus citrinus (Crawf.), was not found in Kabardin-Balkaria in a single species of scale. In the northern Caucasian foothills Comperiella bifasciata How. was not found on poplar and spruce scales although it is the usual parasite of these scales on the Black Sea littoral. In Kabardin-Balkaria its place is taken by another parasite of the female poplar scale — Coccidencyrtus dissimilis, sp. n., which is more effective and abundant than Comperiella bifasciata. On the other hand such species as Pteroptrix longicornis, P. dimidiata, P. maritima, Hispaniella lauri, Prospaltella gigas occur in the northern foothills of the Caucasus more frequently and in considerably larger quantities than in the southern foothills. The parasite A. proclia, which infests a large number of hosts on the Black Sea littoral of the RSFSR, behaves in Kabardin-Balkaria mainly as a parasite of the San Jose scale and is reared freely from other scales. As compared with A. proclia, Prospaltella perniciosa is a San Jose scale parasite of secondary importance.

These preliminary data may be useful as a foundation for the practical use of entomophages in Kabardin-Balkaria, particularly for inter-area settlement.

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THE BLOODSUCKING BLACK FLY (DIPTERA, SIMULIIDAE) FAUNA OF THE KLYAZ'MA RIVER BASIN AND THE BIOLOGY THEREOF

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Although the bloodsucking black flies have been the subject of all-round study in the USSR for a good three decades, owing to their importance as ectoparasites and vectors of infectious diseases, and despite the existence of comprehensive species surveys for a number of areas (Rubtsov, 1956), faunistic studies on these insects are still less complete than in the case of any other group of biting flies.

We have only isolated and fragmentary communications on the black fly fauna of the Volga basin, including the Klyaz'ma River and its main tributaries (Bening, 1924; Olenev, 1940, 1945; Petrisheva and Saf'yanova, 1956).

Benning (1924) indicated four species as infesting the Lower Volga region: Schönbaueria matthiesseni End., Nevermannia maculata Meig.,[1] Cnetha aurea Fries and Wilhelmia equina L. The first of these was noted as a vicious mass bloodsucker.

Olenev (1945) established the presence of six species in the vicinity of Saratov, Lower Volga — two in the pupal stage in the Volga River (S. matthiesseni End. and S. maculatum Meig.) and four in spring-water streams of the Yelshanki River (S. ornatum Mg., S. aureum Fries, S. latipes Meig. and S. venustum Say).

In an earlier paper (1940) Olenev also contributed some information on the presence of S. (Nevermannia) maculatum Mg. in the Lower Volga. This species prefers places "where the current is extremely weak". Petrisheva and Saf'yanova (1956), in a paper on control of black fly larvae in the Klyaz'ma, Peksha and Sen'ga Rivers (Petushki district, Vladimir province), mention the discovery of 18 species of Simuliidae (without giving the complete list), with Boophthora erythrocephala (De Geer) Eusimulium aureum Fries., Simulium argyreatum Mg., S. morsitans Edw. and Odagmia ornata Mg. predominating.

A good deal of material on black fly fauna and biology, in the pre-imaginal stages (larval, pupal) in 14 rivers and a few spring-water streams in the Klyaz'ma basin, and in the imaginal stage in the Moscow and Vladimir provinces, was collected by the present author during the three years 1957-1959.

From the geomorphological point of view the Klyas'ma basin is interesting.

The Moscow province is situated in a forest belt and is generally level with gently sloping ridges and rolling contours in places. The characteristic forests are spruce and pine, with admixtures of broadleaved species — oak, maple, elm and others. The climate is comparatively wet, of the temperate continental type. Mean temperatures range from -11.3° to -10.4° in the coldest month and from +17.1° to +18.5° in the hottest. Mean annual precipitation is between 506 and 676 mm, peak rainfall occurring at the end of July and the beginning of August. Westerly, southwesterly and southerly winds prevail. The entire river system of the Moscow province forms part of the Volga basin. The northernmost part of the province is watered by the right-hand tributaries of the Volga; all the other rivers belong to the Oka system, the Klyaz'ma being the main tributary of that river.

The Vladimir province lies between the Volga and Oka, in a slightly rolling valley. It consists mainly of meadowland, but one thirtieth of the total area is boggy and covered mainly with sphagnum and haircap moss, with some bog shrubs.

Forests occupy 42% of the area. The tree population is mixed, with conifers (pine and spruce) predominating; the deciduous species are birch, aspen and alder.

The Oka, with its tributary, the Klyaz'ma, runs along the southeastern border of the province. The principal tributaries of the Klyaz'ma flow through the province. These rivers are of lowland type, with slow current, broad valleys and meandering channels. High water occurs in spring and wide flood plains are formed. The water level falls in summer but rises again in autumn owing to prolonged rains.

The climate is temperate continental, with mean temperatures of -11° in January and +18.2° in July. Annual precipitation is 500-550 mm.

The Klyaz'ma, a left-hand tributary of the Oka, starts in the Solnechnogorsk district of the Moscow province and enters the Oka near Gorbatov in the Gor'kiy province. It is 647 km long and its basin covers 42,210 km^2; it is 1-4 m wide in its upper course, 100-200 m in its middle course and 250 m in its lower course. The Klyaz'ma is a typical lowland river with a predominantly low level throughout the year and negligible discharge. Only during the spring floods does the water level rise abruptly. The river is navigable for a distance of 124 km from its mouth, and also in the upper course, in the region of the Klyazminsk reservoir. Its largest left tributaries are the Vorya, Sherna, Kirzhach, Koloksha, Uvod', Nerl', Teza and Lukh.

We have at our disposal prepared material from the first seven of these and, in addition, some from comparatively small tributaries of the Klyaz'ma (Malaya Peksha, Lipnya, Sen'ga, Vol'ga, Vorsha), from the Severka (a tributary of the Moskva) and from four spring-water streams.

In all, 24 forms of Simuliidae, belonging to 9 genera, have been detected in the Klyaz'ma basin. Two varieties, Odagmia ornata oblimata Odinz., var. nov. and Byssodon transiens Rubz. var. are described as new.

The table lists the species, with the places where they were found, the growth stages from which they were identified and other data.

Information on the biology of the species discovered is given below.

1. Boophthora erythrocephala (De Geer). Pupae collected from the Klyaz'ma and Severka Rivers. In places the pupae were attached to pondweed leaves (Potamogeton) at a depth of 10 cm, where the current speed was 0.3 meters per second and the temperature 10°. Pupation and emergence of the adult insects at the end of May and in the first half of June. Bloodsucking.

2. Byssodon transiens Rubz. (Rubtsov) var. (Fig. 2). The new variety of the species from the Klyaz'ma River (Petushki district, Vladimir province) differs from the typical form (Rubtsov, 1956) in the following respects:

♂♂. Gonocoxite half as long again as it is high, instead of the other way round. 3rd antennal segment dilated. Terminal segment of maxillary palpus twice as long as the pre-

[1] Corresponding to Titanopteryx maculata Mg. and Eusimulium aureum Fries. in Rubtsov's classification (1956).

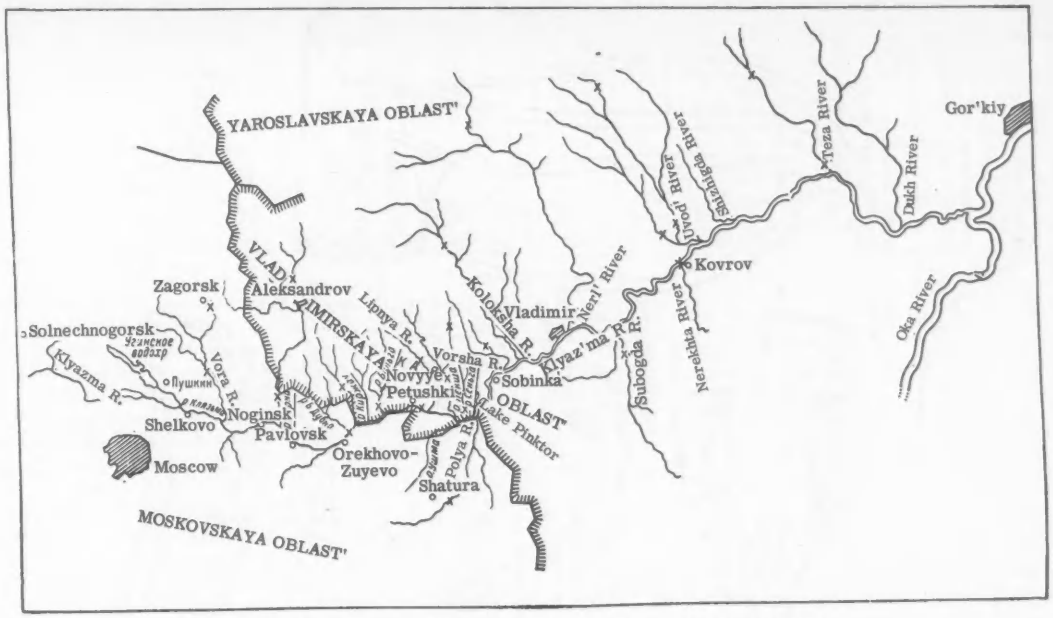

Fig. 1 - The Klyaz'ma River and its tributaries. x - black fly collection points.

apical.

♀♀. No prominent thickenings anteriorly on branches of genital rod. Main shaft of genital rod a good deal longer, with distinguishing configuration. Cerci appreciably wider than high. Terminal segment of maxillary palpus more than twice as long as preceding segment.

Larva. Body length 4.6-4.7 mm. Pigmentation of frons shown in the sketch. Frontal sclerite covered with bifid setae. Second antennal segment not longer than 1st but equal to it. Three instead of two marginal mandibular teeth. Four or five instead of two or three marginal setae on submentum.

Pupa. Cocoon and branching of respiratory filaments as in typical form. Trichomes on dorsum not simple but branched. Height of sharply conical end-plates on head and dorsum 4 or more times greater than their median thickness (instead of 2-3 times).

Biology. Develops in comparatively small rivers 8-15 m wide where the current is slow (0.3-0.5 meters per second) and the depth is 1.5-2.0 meters. Larvae and pupae have been found on leaves of water sedge (Carex sp.) and osiers (Salix triandra L. and S. alba L.) submerged 15-25 cm. Water temperature in pupation season 8°. Pupation and emergence at end of May and the first half of June.

Distribution: Klyaz'ma, Peksha, Malaya Peksha, and Vorsha Rivers (Vladimir province, Odintsov).

3. Eusimulium sp. gr. aureum Fries. Pupae found on 28 May 1957 in low, dense aquatic vegetation of Sen'ga River (Petushki district, Vladimir province) in places where the river is 3 m wide and 1 m deep. Pupae found on leaves of Potamogeton sp. and Carex sp. on 23 June 1957, and also on leaves of hornwort Ceratophyllum submersum L. In both cases the current at the point of collection was 0.5-1.0 meters per second and the temperature 10-12°.

4. Eusimulium latipes Mg. Pupae found in crevices of small stones taken from a depth of 1.3 m in the Klyaz'ma River, where the current speed was 1 meter per second and the temperature 14° (21 May 1957; Petushki, Vladimir).

5. Eusimulium latizonum Rubz. Larvae found on 31 May 1957 in the small Vol'ga River (width 6 m, depth up to 2 m) on Carex sp., Potamogeton sp., submerged 15-20 cm. The river bottom is silty in the places where the specimens were collected; depth 1.5 m, current 0.6 meters per second, temperature of the water 13°.

6. Odagmia sp., gr. ornata Mg. Occurs frequently. Found in Peksha, Malaya Peksha, Lipnya, Kirzhach, Severka, Vorya, Vorsha and Uvod' Rivers, and in the spring-water stream flowing into the Peksha River, and in the spring-water stream flowing into the Severka River. Larvae and pupae in parts of rivers and streams where the bottom is sandy, gravelly or silty, with a water temperature of 8-11°, on leaves of Ceratophyllum submersum L. and on silt-covered branches of Salix triandra L. submerged 5-40 cm. Pupae on stems of dandelion, Taraxacum officinale Wigg. The rivers were 10-15 m broad and 0.5-1.5 m deep at the collection points and the current 0.2-1.0 meters per second; the streams were up to 20 cm wide and up to 15 cm deep with a current speed on sandbanks of up to 0.6 meters per second.

In view of the fact that larvae were found from the first ten days of May to the second ten days of October it can be assumed that the species produces two generations a year in the Moscow and Vladimir provinces. Bloodsucking.

7. Odagmia ornata ornata Mg. Found in Severka and in spring water stream flowing into the Peksha River in places where the water is relatively cold (10-11°) and the current 0.6-1.0 meters per second. The bottom and the plants on which the larvae and pupae were found were silted over. In both instances the breeding sites were near livestock farms. Pupation and emergence of the imago recorded during the last ten days of August. Bloodsucking.

8. Odagmia ornata oblimata Odinz., var. nov. Similar to O. ornata ornata Edw. Main distinguishing features — structure of respiratory filaments, their relative length and thickness; structure of male genitalia (ventral plate and dististyle). Male gonopleura differ from those of O. ornata ornata Edw. in shape and marginal markings.

♂♂. Lip of ventral plate rostrally reclinate terminally; hooks of ventral plate with shallow excision dorsally in lower third, their superior extremities being more reclinate. Teeth of ventral plate visible in profile and extending farther anteriorly along the dorsal margin. Dististyle basally half as wide again as apically (gs_1, gs_2), its width (at swelling) being one third of its greatest length. Dististyle spine long. Parameres with 42-44 denticles of equal size except for two or three larger ones on the free extremity. Gonofurca with almost parallel margins, its base elongated in the shape of a bar. Antennae black. Terminal segment of maxillary palpus

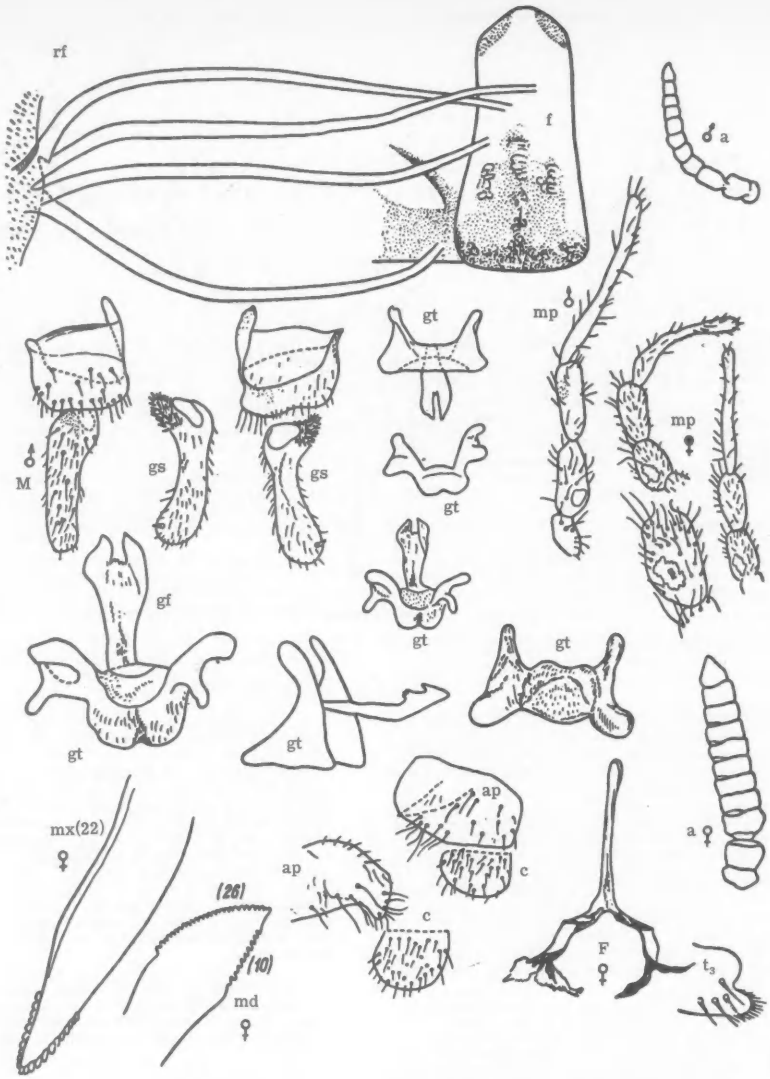

Fig. 2 - Byssodon transiens Rubz. var.: ♂M - male genitalia; ♀F - female genitalia; gs - dististyle; gt - ventral plate; gf - gonofurca; mx(22) - larval maxillae (22 denticles apically); md - larval mandibles (10 and 26 - number of teeth marginally); ap - anal plate; c - cerci; rf - respiratory filaments; a - antenna; mp - maxillary palpi; t_3 - hind tarsus; f - larval frons.

two and a half times longer than the preceding one (third). Middle tibia and first segment of hind tarsus, basally, yellowish to almost half their length. Heel of first segment of hind tarsus long, sharp and three-quarters the width of the segment. Scutum velvety-black with two silvery reniform spots clearly distinguishable and medially reclinate above. Sparse bright orange hairs visible between and below them. Halteres bright orange, basally dark cinnamon-brown.

♀♀. Grayish tones predominate in body color. Face and frons silvery-gray, mat. Second segment of maxillary palpus has appreciably more setae; Lauterborn's organ ovate, longer basally than the diameter of the segment, the aperture set laterally forward. Distinct silvery-gray spot on scutum, its contour differing from that of O. ornata ornata Mg. Scutum laterally covered with sparse golden hairs. The two basal antennal segments have a yellow tinge. Wing membrane transparent, opalescent with the whole range of rainbow colors. Halteres light yellow, basally light brown. Coxae and bases of femora of all legs a bright silvery-white except in their apical parts, which are dark brown. Tibia and first tarsal segment yellowish over more than half their length from the base. Tooth of tarsal claw small, almost equal in height to tubercle at base of claw.

Larva unknown.

Pupa: Cocoon simple, dense, with a conspicuously thickened border on its anterior end. 1st branch of respiratory filaments (superiorly) slightly shorter than 2nd, 3rd shorter than 4th, 5th slightly shorter than sixth, 7th shorter than 8th by almost a half. All four pairs of filaments in planes sharply canted in relation to the sagittal suture. Respiratory filaments appreciably thicker basally than outwardly

Table 1

Mount number	Species or form	Klyaz'ma	Peksha	Malaya Peksha	Lipnya	Sen'ga	Kirzhach	Severka	Vorya	Vol'ga	Vorsha	Uvod'	Nerl'	Sherna	Koloksha	Spring-water stream flowing into Peksha R.	Spring-water stream flowing into Severka R.	Spring-water stream flowing into Lake Piktor	Spring-water stream at 169-km mark, Vlad. road	Number of places found (rivers, streams)	Growth stages from which identified	Bloodsucking activity (our observations)	Previously recorded bloodsucking activity
1	*Boophthora erythrocephala* (De Geer)	+						+												2	p. i.	bl.	f. bl.
2	*Byssodon transiens* var.	+	+	+							+									4	l. p. i.	–	–
3	*Eusimulium angustitarse* Lundstr.																+			1	l. p. i.	–	bl.
4	*E. latipes* Mg.	+								+	+	+								4	p.	–	f. bl.
5	*E. latizonum* Rubz.									+										1	l.	–	bl.
6	*Eusimulium* sp. gr. *aureum* Fries.						+										+			2	p.	–	–
7	*Odagmia ornata ornata* Mg.							+								+				2	l. p. i.	bl.	f. bl.
8	*O. ornata oblimata* Odinz., var. nov.																		+	1	l. p. i.	–	–
9	*O. ornata pratorum* Fried.		+			+										+	+			4	l. p.	–	bl.
10	*O. frigida* Rubz.		+																	1	l.	–	bl.
11	*Odagmia* sp. gr. *ornata* Mg.		+	+	+		+	+		+	+	+				+	+			10	l. p. i.	bl.	not rec. as bl.
12	*Simulium argyreatum* Mg.					+														1	p.	–	f. bl.
13	*S. morsitans* Edw.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		16	l. p. i.	bl.	bl.
14	*S. morsitans simulans* Rubz.		+	+		+														3	p.	–	not rec. as bl.
15	*S. morsitans curvistylus* Rubz.		+	+		+														3	l. p. i.	–	–
16	*S. paramorsitans* Rubz.		+																	1	l.	–	bl.
17	*S. galeratum* Edw.	+	+	+			+			+	+									6	l. p. i.	bl.	f. bl.
18	*S. nölleri* Fried.			+								+								2	l.	–	–
19	*S. truncatum* Lundstr.					+														1	p.	–	f. bl.
20	*S. hönbaueria matthiesseni* End.	+	+	+			+		+	+	+		+	+	+	+				11	l. p. i.	bl.	bl.
21	*S. pusilla* Fries.		+	+																2	l. i.	bl.	bl.
22	*Titanopteryx maculata maculata* Mg.	+	+	+						+	+		+		+					7	l. p. i.	f. bl.	f. bl.
23	*Wilhelmia secunda* Bar.							+												1	p. i.	–	bl.
24	*Stegopterna richteri* End.																+			1	l.	–	–
	Number of species (or forms) discovered in rivers and streams	7	12	10	2	7	4	5	2	7	7	4	3	2	3	5	5	1	1	87			

Note: l. -larva, p-pupa; i-imago; bl. -bloodsucking; f. bl. -fierce bloodsucking; not rec. as bl. -not recorded as bloodsucking.

in 2nd and 3rd pairs.

Biology: Pupae found on 7 May 1959 in a small spring flowing out of a bog-burst, the water being turbid and densely covered with aquatic vegetation. Current speed on sandbanks 0.3-0.5 meters per second, temperature 14°. Sedge (Carex sp.) to which pupae were attached was covered with sludge. Imagoes reared from pupae in laboratory.

Distribution: Spring-water stream at 169-km marker, Vladimir highway (Sobinsk district, Vladimir province, coll. V. Odintsev).

Type preserved in Institute of Zoology, Academy of Sciences, USSR, Leningrad.

9. Odagmia ornata pratorum Fried. Occurrence comparatively rare; larvae and pupae found in Peksha and Sen'ga Rivers and in the spring-water stream flowing into the Peksha and the spring-water stream flowing into the Severka where there is dense vegetation on the banks (osiers — Salix alba L., sedge), or on hornwort leaves (Ceratophyllum submersum L.) submerged 15-20 cm. Current speed at collection points 0.3-1.0 meters per second, temperature 10-12°. Pupation and beginning of eclosion of imago in the last ten days of June.

10. Odagmia frigida Rubz. Found in Peksha River on 30 May 1957 on foliated branch of gray alder, Alnus incana Mnch., fastened to bank. The larvae were situated on its leaves at a depth of 25 cm; the current speed here was 0.3 meters per second, the temperature 8°, the river 12 m wide and 2 m deep.

11. Simulium argyreatum Mg. Pupae found in Sen'ga River (Petushki district, Vladimir province) on 28 May 1957 on osier brushwood in a sector 3-4 m wide and 1.5 m deep. The pupae were situated on the underside of the leaves of angustifolious plants (water sedge, Carex sp.) at a depth of 20 cm, the current speed being 0.3 meters per second and the temperature 10.5°.

12. Simulium morsitans Edw. Occurrence frequent; found in Klyaz'ma, Malaya Peksha, Sen'ga, Kirzhach, Severka, Vorya, Vol'ga, Vorsha, Uvod', Nerl', Sherna, Koloksha Rivers and in the spring-water stream flowing into the Peksha River in places from 10-60 cm to 1.5 m deep and from 3-4 to 12-15 m wide where the bottom is predominantly sandy, and silted in places; water clear, temperature 8-14°. Favorite places for attachment of larvae and pupae are leaves of old alder boughs (Alnus incana Mnch.), silted up on to the bank and aquatic plants (Carex sp., Ceratophyllum submersum L. and pondweed — Potamogeton sp.) submerged 10-40 cm; collected at places where the current speed was 0.1- 0.5 meters per second. Pupation and emergence in the last ten days of May and the first ten of June. Our data thus indicate that the southern distribution boundary for this species must be considerably modified to include the Moscow province, the species not having been found south of the northern Moscow province border until now (Rubtsov, 1956).

13. Simulium paramorsitans Rubz. Rare. Larvae found on 30 May 1957 in a small sector of Peksha River on

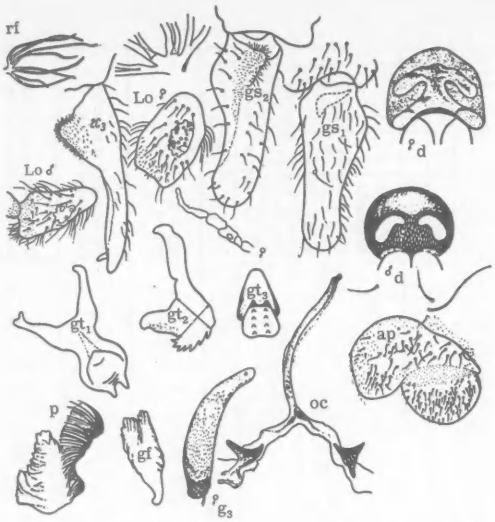

Fig. 3 - Odagmia ornata oblimata Odinzov, var. nov. Genitalia of male: p - parameres. Genitalia of female: oc - oviductus communis. Other legends: ♂d - markings of male scutum; ♂f - markings of female scutum; Lo - Lauterborn's organ. Other legends as for Fig. 2.

sedge leaves at a depth of 10 cm. Bottom sandy, silty, current speed 0.3 meters per second, temperature 10°. Condition of mature larvae indicate pupation and eclosion of imago as occurring probably in the first half of June.

14. Simulium morsitans curvistylus Rubz. Rare. Larvae and pupae found on 28, 30 and 31 May 1957 in Peksha, Malaya Peksha and Sen'ga Rivers along with S. morsitans simulans Rubz. in sectors with sandy bottom and overgrowth of brush and grasses. Pupae were on angustifolious plants (Carex sp. Ceratophyllum submersum L.). Pupation and eclosion of imago at the end of May and in June, at water temperature of 10.5-11°.

15. Simulium galeratum Edw. Frequent. Found in Klyaz'ma, Peksha, Malaya Peksha, Kirzhach, Vorya, and Vorsha Rivers in sectors up to 12 m wide and 2 m deep with sandy and in places silty bottom. Larvae and pupae found at a depth of 10-25 on angustifolious plants (most often on Carex sp.) and on leaves and bark of mudcovered alder boughs in sectors where the current is relatively slow (0.2-0.5 meters per second). Develops in conjunction with S. morsitans survistylus Rubz., Titanopteryx maculata Mg. and Byssodon transiens var. nov. Pupation and emergence of imago at the end of May and the beginning of June. Bloodsucking.

16. Simulium morsitans simulans Rubz. Comparatively rare. Pupae found on 30 and 31 May 1957 in Severka, Peksha, and Malaya Peksha Rivers on blackened bark of an alder log which had lain for a long time in the water and on boughs of Salix triandra L. The river bottom at the collection sites was sandy, in places silty. Depth of submergence 15-20 cm, current speed 0.3-0.5 meters per second.

17. Simulium nölleri Fried. Rare. Larvae found on 28 May 1957 in Malaya Peksha River and on 30 May in Uvod' River, on mud-covered parts of angustifolious plants (Carex sp., Ceratophyllum submersum L.) submerged 15-20 cm, current speed 0.5-0.7 meters per second, temperature 12°.

18. Simulium truncatum Lundstr. Pupae found on 31 May 1957 in Sen'ga River on leaves of Ceratophyllum submersum L., at a depth of 5 cm, current speed 0.3 meters per second, temperature of water 9°.

19. Schönbaueria matthiesseni End. Mass species. Found in Klyaz'ma, Peksha, Malaya Peksha, Vol'ga, Vorsha, Uvod', Sherna, Koloksha Rivers and spring water stream flowing into the Peksha River in sectors with sandy and in places silty bottom, width up to 8-12 m, depth 1.2-2.0 m. Pupae and larvae attached to leaves and bark of old willow stumps with roots silted up on to the bank and on Carex sp. leaves at a depth of 10-25 cm. In Klyaz'ma River the pupae were attached in crevices of small bottom stones at a depth of 1.3 m. Current speed at collection sites 0.2-1.0 meters per second, temperature of water 8-20°. Pupation and emergence of imago in the last ten days of May. It is noteworthy that the species occurs not only in medium and small rivers (Rubtsov, 1956), but also in spring streams. Such a stream, which enters the Peksha River, is almost 150 m long, and takes its source from a natural well thickly overgrown with forest vegetation and nettles; it flows near a livestock farm. The width is 15-26 cm and the depth on the sandbanks where the pupae and larvae were gathered from old alder boughs was 10-15 cm; current speed about 1.0 meters per second. Bloodsucking.

20. Schönbaueria pusilla Fries. Rare. Pupae found in small Peksha and Malaya Peksha Rivers along with S. matthiesseni End. Pupation and emergence in last ten days of May and beginning of June. Bloodsucking. The discovery of this species south of the Vladimir province appreciably enlarges its distribution area, which had previously been known as restricted to the northern rivers of the USSR (Rubtsov, 1936).

21. Titanopteryx maculata maculata Mg. Frequent. Found in Klyaz'ma, Peksha, Malaya Peksha, Vol'ga, Nerl', and Koloksha Rivers in places with sandy bottom, on leaves of Carex sp. and of submerged alder boughs as well as on the underside of bottom stones; submergence depth invariably ranged from 5 to 25 cm. Water temperature at collection sites 8-14°, current speed 0.3-1.0 meters per second.

The larvae and pupae of T. maculata Mg. were hitherto known as developing in large rivers. Rubtsov, however (1956), suggested that one of its forms, T. maculata maculata Mg., could develop also in medium-sized rivers and cited the Voronezh River and the Moskva River as examples. Our data thus fully confirm the hypothesis; T. maculata maculata Mg. has been found by us in small rivers with an average width of 10-15 m and an average depth of not more than 1.5 m. Pupation and eclosion of imago in the latter third of May and the first half of June. Vicious bloodsucker.

22. Wilhelmia secunda Bar. Pupae found in Severka River (Mikhnevsk district, Moscow province) on 27 September 1959 on angustifolious aquatic grasses. Water at collection sites clear, current speed 0.3 meters per second, temperature 7°. Adult insects were reared from pupae in laboratory.

23. Stegopterna richteri End. Larvae collected on 3 May 1959 in small spring stream flowing near settlement. This stream was muddy and thickly covered with aquatic vegetation; depth 10-15 cm, current speed 0.2 meters per second, temperature 11°.

24. Eusimulium angustitarse Lundstr. Larvae found on 17 April 1959 in small spring stream entering Severka River. Larvae attached to leaves of aquatic grasses. Water clear, current speed 0.3 meters per second, temperature 12°. The larvae were transferred to an aquarium; pupation started on their second day in the laboratory, the pupal stage lasting 5 days and ending with the emergence of adult insects.

We observed the bloodsucking activity of black flies in relation to meteorological conditions at a number of places in the basin under study for three seasons, 1957-1959. The results are the subject of a separate paper and here we shall confine ourselves to mentioning only a few of our findings.

Bloodsucking black flies are ubiquitous throughout the Klyaz'ma basin, occurring in very large numbers in some areas. They attack man and domestic animals on a mass scale and, as regards their activity, are second in importance to the genus Aëdes.

As regards frequency of occurrence and ferocity the most important species in the Klyaz'ma basin are Simulium morsitans Edw. in forest country and Schönbaueria matthiesseni End. in meadow-forest-steppe country.

The black flies of the genus Odagmia are represented in our collections by three varieties of O. ornata Mg.: O. ornata ornata Mg., O. ornata pratorum Fried., O. ornata oblimata Odinz., var. nov. and O. frigida Rubz.

According to our observations mass emergence of O.

ornata Mg. occurred in the Klyaz'ma basin from the first ten days of June to 18-25 August, coinciding with the period of peak summer temperatures.

Here we must again emphasize the special epidemiological importance of this group of black flies, which are known to us as vectors of the pathogenic agent of cattle onchocerciasis (Beltyukova, 1954).

In studying the biology of the black flies in their aquatic stages we also frequently came across appreciable numbers of caddis fly (Trichoptera) larvae in the habitats of the black fly larvae and pupae. This leads one to speculate on the possibility that such places may be peculiar feeding sites for these predators. The question has not merely theoretical but also practical importance; we therefore collected these larvae at the same time as the aquatic-stage black fly larvae.

In the course of processing the black fly material we opened the Trichoptera larvae and examined the intestinal contents.

In 78 individuals studied, belonging to the families Polycentropidae and Hydropsychidae the intestines contained residues of black fly larvae and pupae: larval head capsules and oral appendages, caudal suckers, pupal legs, wings and other parts. The number of identical organs and body parts found in each Trichoptera larva intestine indicated that in certain cases twenty or more black fly individuals had been devoured.

Taxonomic comparison of the preserved chitinous parts of black fly larvae and pupae extracted from caddis fly intestines with those of Simuliidae collected at the same time enabled us, first, to establish the genus, and in certain cases even the species of the Simuliidae which had been devoured by the Trichoptera and, secondly, to verify our hypothesis concerning the role of Trichoptera larvae of the families mentioned as predators on black flies in the aquatic stages.

In conclusion, I take the opportunity of expressing my warm thanks to I. A. Rubtsov for his great help and valuable advice.

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WHAT IS THE GENUS THAUMATOPHYMA RME. (ORTHOPTERA, ACRIDIDAE, CATANTOPINAE)?

L. L. MISHCHENKO

Through the kindness of Dr. H. Schiemenz, to whom my warm thanks are due, I had an opportunity of examining the male paratype of Thaumatophyma cercatum Ramme preserved in the Humboldt University Zoological Museum, Berlin (German Democratic Republic).

The genus Thaumatophyma Rme. was erected by W. Ramme in 1939 (Ramme, 1939, page 148) on the basis of two new species from the Afghan mountains (West Hindukush and Paghman Range), Th. cercatum Rme. and Th. corallipes Rme., which he described at the same time (op. cit., page 149). Th. cercatum was the generic type.

While I was dealing with the subfamily Catantopinae in connection with the joint work published by G. Ya. Bey-Biyenko and myself (Mishchenko, 1951: 137-138), I was obliged to include the genus Thaumatophyma Rme. in this subfamily, only to come up against exceptional difficulties in distinguishing it from the similar genera Bienkoa Mistsh. (Mishchenko, 1950a: 791), Conophyma Zub. (Zubovskiy, 1898: 105) and Plotnikovia Um. (Umnov, 1930: 72) when I was composing a key for identification of the Catantopinae genera with which I was concerned in that work.

Ramme's very brief description of the genus Thaumatophyma Rme. itself, and his even briefer descriptions of the species in this genus, were unfortunately too general to help me at all in this difficult task. The only point I discovered from an examination of the drawings contained in his paper was that the last abdominal segment in the male is entire, not medially excised. (Ramme, 1939: 148, Abb. 59a). I then began to suspect that this genus was merely a synonym for Conophyma Zub. This suspicion was later strengthened when I studied Catantopinae again for "Fauna of the USSR", and I mentioned the point in a new paper (Mishchenko, 1952: 216). Owing to lack of material on this genus in the collections of the Zoological Institute of the Academy of Sciences, USSR, and the impossibility of studying Ramme's types at that time, I again had to use Ramme's drawing of the apex of the male Th. cercatum Rme. abdomen so as to distinguish between Taumatophyma Rme. and Conophyma Zub. in the Catantopinae key for "Fauna of the USSR".

Having now examined the paratype of Th. cercatum Rme., I have discovered that this male was very badly prepared. As the whole sexual apparatus was greatly extruded (the specimen was apparently captured when preparing to copulate or in the act of copulating), so as to conceal the entire anal plate, which was deeply recurved into the abdomen, the result was to raise the cerci unnaturally high. Ramme took this to be the normal position of the cerci, and even mentioned the point in his diagnosis of the genus Thaumatophyma Rme.: "Cerci sehr lang, von unregelmässiger Form, zugespitzt, aufwärts und mehr oder weniger vorwärts gerichtet" (Ramme, 1939: 148). I carefully separated the copulatory apparatus and drew the anal plate out of the abdominal cavity; the cerci themselves then immediately dropped into a completely different position, so that it became possible to examine properly the structure of the abdominal apex. The last abdominal tergite proved to be medially excised and to bear on its posterior margin the narrow lobes characteristic of most males of species belonging to the genus Conophyma Zub. and it also became clear that Ramme's drawing was inaccurate (Ramme, 1939: 148, Abb. 59a).

Further detailed study of the Th. cercatum Rme. male showed that this species has all the characters of the genus Conophyma Zub., namely: parietal foveae very indistinct, fore and mid femora slightly but distinctly enlarged, hind tibiae with external and internal apical spines, tympanal organ lacking from 1st abdominal tergite, epiphallus (Fig. 1), transverse, with 4 sharp, immobile, conical tubercles, just as in many Conophyma Zub. species (Figs. 2-8). Conversely the absence of any characters by which these genera could be distinguished from each other obliges one to regard Thaumatophyma Rme. as a synonym for Conophyma Zub., and its species must be assigned to the latter genus.

Owing to the presence of long cerci in the male, extending well beyond the apex of the genital plate, C. cercatum (Rme.) must be classed as a member of the group consisting of C. tarbinskii Mir. (Miram, 1931: 71, Fig. 2), C. sogdianum Mistsh. (Mishchenko, 1950b: 33, Fig. 1[17]), C. turcomanum Mistsh. (Mishchenko, 1950c: 215, Fig. 1[14]), C. ikonnikovi Uv. (Uvarov, 1925: 559), C. excellens Mistsh. (Mishchenko, 1950c: 215, Fig. 1[15]), C. lobulatum Mistsh. (Mishchenko, 1950c: 215, Fig. 1[16]), and C. splendidum Mistsh. (Mishchenko, 1950a: 790, 791, Fig. 1[4]). In the structure of the cerci, shape of the anal plate and shape of the epiphallus this species most resembles C. ikonnikovi Uv.

The true position of C. cercatum (Rme.) can be seen from the following key.

Key for Identification of Species of the Genus Conophyma Zub. in which the Male Cerci Extend Well Beyond the Apex of the Genital Plate

1 (10). Lobes of last abdominal tergite in male, if developed, apically sharply angled or very slightly rounded (Figs. 9-11); sometimes, however, these lobes completely lacking (Figs. 12, 13).

2 (9). Lobes of last abdominal tergite in male well separated. Posterior median projection of anal plate in male more protuberant than posterior angles of anal plate (Figs. 9, 10, 12, 13).

3 (8). Male cerci curved inward, gradually narrowed, not thickened, towards apices (Figs. 9, 12, 13); bent or curved downwards in profile (Figs. 17-19).

4 (7). Posterior margin of last abdominal tergite in male without lobes. Anal plate in male distinctly spatulate (Figs. 12, 13).

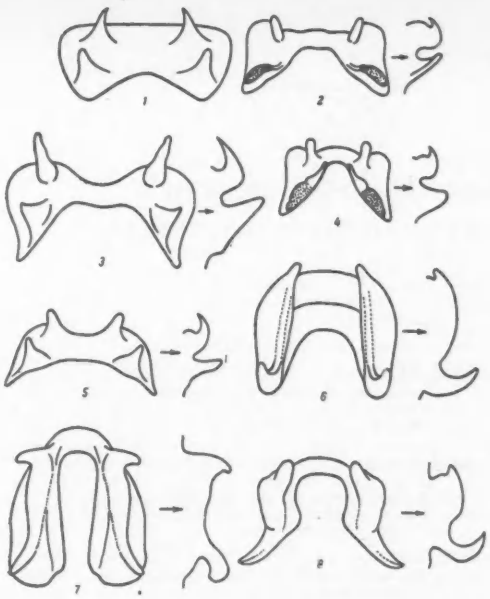
5 (6). Cerci in male strongly narrowed towards apex, apically bent sharply and strongly downward (Fig. 17). USSR: South Uzbekistan, southwestern part of Hissar Range..... C. tarbinskii Mir.

6 (5). Male cerci in profile slightly narrowed apically, gradually curving slightly downward (Fig. 18). USSR: Uzbekistan, western spurs of Zeravshan Range..... .....C. sogdianum Mistsh.

7 (4). Lobes of last abdominal tergite in male distinct, triangular, angulate. Anal plate in male slightly but distinctly narrowed apically (Fig. 9). USSR: Turkmenia, Kopet-Dag.....C. turcomanum Mistsh.

8 (3). Male cerci straight, widened inwardly before the acuminate apex (Fig. 10); in profile straight, not curved downward (Fig. 20). USSR: Tadzhikistan, Darvaz Range..... C. ikonnikovi Uv.

9 (2). Lobes of last abdominal tergite in male basally contiguous, but slightly separated at the apices.



Figs. 1 - 8: Epiphallus ♂. 1 - Conophyma cercatum (Rme.) (paratype); 2 - C. tarbinskii Mir. (paratype); 3 - C. sogdianum Mistsh. (paratype); 4 - C. turcomanum Mistsh. (paratype); 5 - C. ikonnikovi Uv.; 6 - C. excellens Mistsh. (paratype); 7 - C. lobulatum Mistsh. (paratype); 8 - C. splendidum Mistsh. (holotype).

Posteromedial prominence of anal plate in male almost as prominent as posterior angles of anal plate (Fig. 11). Afhanistan: Western Hindu Kush.....C. cercatum Rme.

10 (1). Lobes of last abdominal segment in male apically rounded (Figs. 14-16).

11 (12). Lobes of last abdominal segment in male well separated. Lateral margins of anal plate in male strongly excavated (Fig. 14). USSR: Tadzhikistan. Peter I Range.....C. excellens Mistsh.

12 (11). Lobes of last abdominal tergite in male contiguous (Fig. 15) or very slightly separated (Fig. 16), when the posteromedial prominence of the anal plate is as prominent as its posterior lateral angles (Fig. 16). Lateral margins of male anal plate almost straight (Figs. 15, 16).

13 (14). Lobes of last abdominal tergite in male contiguous, prominent (Fig. 15). Posterior angles of anal plate in male angulate and more prominent than posteromedial prominence of anal plate (Fig. 15). USSR: Tadzhikistan, Peter I Range.....C. lobulatum Mistsch.

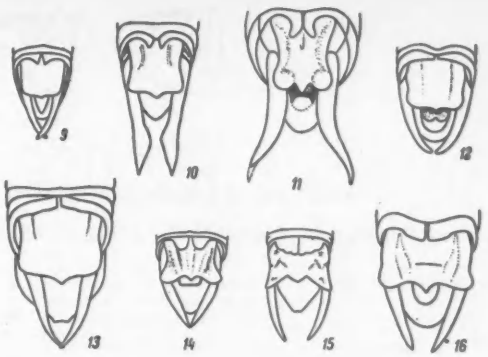
14 (13). Lobes of last abdominal tergite in male slightly but distinctly separated, slightly projecting (Fig. 16). Posterior angles of anal plate in male rounded and as prominent as posteromedial prominence of anal plate (Fig. 16). USSR: Tadzhikistan, Darvaz Range..... ..... C. splendidum Mistsh.

As Ramme's description of C. cercatum (Rme.) is very brief, I think it essential to give a more detailed description of this species.

Conophyma cercatum (Rme.). (Figs. 1, 11, 21).

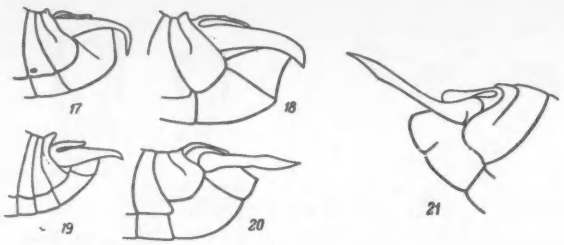
Ramme, 1939: 149, Figs. 59a-c (Thaumatophyma) (♂, ♀; Afghanistan, Western Hindu Kush: Andarab, Banu); Mishchenko, 1951: 184, Fig. 146, (Thaumatophyma); Mishchenko, 1952: 216, Fig. 81 (Thaumatophyma).

♂. Body medium-sized, glabrous except for



Figs. 9 - 16: Apex of male abdomen, superior view. 9 - Conophyma turcomanum Mistsh. (holotype); 10 - C. ikonnikovi (paratype); 11 - C. cercatum (Rme.) (paratype); 12 - C. tarbinskii Mir. (holotype); 13 - C. sogdianum Mistsh. (holotype); 14 - C. excellens Mistsh. (holotype); 15 - C. lobulatum Mistsh. (holotype); 16 - C. splendidum Mistsh. (holotype).

sparse hairs. Head large, strongly protuberant. Vertex slightly depressed, lacking median carina, its width between compound eyes one and a quarter times that of the frontal ridge between the antennae. Antennae slender, 21-segmented, almost as long as head and pronotum combined. Pronotum glabrous, short, densely punctulate anteriorly, more coarsely punctate posteriorly, slightly convex; anterior transverse furrow very weak, barely visible between median and lateral carinae; median transverse furrow sharp, running from pronotal disc to lateral lobes of pronotum; posterior transverse furrow sharp; median carina weak but distinct; lateral carinae very weak, especially medially and posteriorly, converging abruptly with median carina anteriorly, parallel with it medially fading out completely posteriorly; lateral lobes trapezoidal. Mesonotum densely punctulate; median carina weak, lateral carinae lacking. Postnotum densely punctulate; median carina weak but distinct, lateral carinae barely visible. Hind femora fairly stout, their length 3.4 times their greatest width. Upper side of posterior tibiae with 8-9 spines on outer and inner margins. Pulvilli between claws of all tarsi small, falling just short of or reaching the middle of the claw. Prothorax with a short conical prominence. Mesothorax with large, fairly sparse punctures; minimum width of space between lateral lobes very slightly exceeding its length. Metathorax coarsely and sparsely punctate; its maximum width almost equal to the combined lengths of the meso- and metathorax. 1st abdominal tergite punctulate, with weak lateral carinae; median carina sharp. Lobes of last abdominal tergite large and narrow, basally contiguous, apically slightly separated, attaining almost one third the length of the anal plate, almost rectangular, with apical part somewhat extended laterally and with slightly rounded apices; space between the lobes triangular. Anal plate longitudinally elongate, medially narrowed, clearly widened basally and apically, its length distinctly exceeding its maximum width, with two sharp longitudinal furrows along lateral margins and with an extremely weak median depression basally, in profile abruptly arcuate basally, and then undulate; posterior margin medially with a sharp, triangular projection, almost as prominent as the posterior angles; posterior angles broadly rounded, extending fairly strongly forward and laterally. Cerci distinctly curved above the middle, gradually narrowing towards the acuminate apices, extending well beyond apex of genital plate; length of cerci almost twice that of anal plate; in profile they are distinctly raised and basally broad, then narrow sharply towards the acuminate apices, becoming distinctly broadened only a little before apices. Genital plate short, bluntly truncate, slightly rounded. Basic color black, shining. Lower part



Figs. 17 - 21: Apex of male abdomen, lateral view. 17 - Conophyma tarbinskii Mir. (holotype); 18 - C. sogdianum Mistsh. (holotype); 19 - C. turcomanum Mistsh. (holotype); 20 - C. ikonnikovi Uv. (paratype); 21 - C. cercatum (Rme.) (paratype).

of head yellowish. Antennae brown. Pronotum, mesonotum and postnotum above unicolorous, black, as are their lateral lobes. Femora of all legs black and brown above. Hind femora with outer and inner knee lobes yellow; inner and lower sides yellow. Hind tibiae yellow; apices of spines black. Thorax and abdomen below yellow. Abdomen almost unicolorous above, only apically yellow and brown and with a weak, narrow, longitudinal band along median carina.

Body length of male, 15.2 mm; pronotum 2.6 mm, hind femora 8.3 mm.

Material studied — 1 ♂ (paratype).

Aghanistan, western Hindu Kush, Andarab, Banu, August 1936, 1 ♂ (paratype)(G. and Ye. Kotssh).

Habitat at latitudes of 2000-2500 m.

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A NEW SPECIES OF THE GENUS ODONTOPODISMA DOV.-ZAP. (ORTHOPTERA, ACRIDIDAE) FROM THE RUMANIAN PEOPLE'S REPUBLIC

BELA KISH

In 1951 W. Ramme (1951: 45-56), studying the collections of the genus Odontopodisma Dov.-Zap. in many European museums, established that the only species of that genus known at the time, O. schmidti (Fieb.) consisted of four species (O. schmidti (Fieb.), O. fallax Rme., O. decipiens Rme. and O. albanica Rme.), readily distinguishable from one another by the shape of the anal plate, the structure of the male genitalia and the shape of the female genital plates.

Study of the grasshoppers on Mt. Cozia in the South Carpathians (Rumania) revealed yet another species, hitherto unknown to science, of the genus Odontopodisma Dov.-Zap, which is described in this paper.

The types and some of the paratypes of the new species are kept in the collections of the Faculty of Zoology, Babesi-Boljai University, Cluj, Rumania; two paratypes are in the Institute of Zoology, Academy of Sciences, USSR, Leningrad.

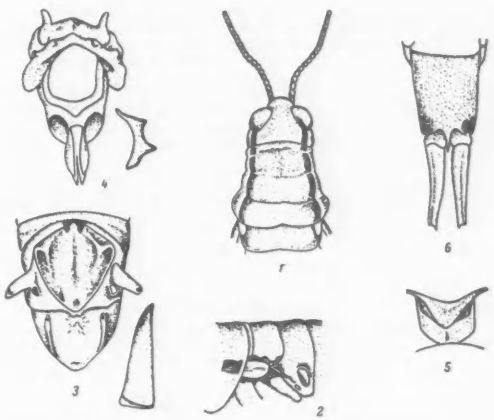
My sincere thanks are due to L. L. Mishchenko, Senior Scientific Officer of the Institute of Zoology, for kindly comparing the new species found by me with other species of the genus Odontopodisma Dov.-Zap. kept in the Institute's collections.

Odontopodisma carpathica Kis, sp. n. (Figs. 1-6).

♂. Body fairly small. Antennae short and thick, scarcely longer than head and pronotum combined, with slightly elongated medial segments; length of individual medial segment 1.25-1.5 times in excess of its greatest width. Pronotum cylindrical, barely widened toward posterior margin; transverse striae sharp. Prothorax with a very broad conical tubercle, the apex of which is rounded. Space between lateral lobes of metathorax almost square. Tegmina barely developed, usually falling well short of posterior metanotal margin or, if they do reach it, not covering the tympanal organ. Lobes of last abdominal tergite straight, parallel, acuminate. Anal plate oblong-triangular, glabrous, its maximum width very slightly less than its length; apex rounded, not extended. Paraprocts oblong-triangular, bearing one distinct tooth at the base of each cercus. Genital plate slightly elongated, oval. Hood short triangular. Cerci short and thick, conical, with almost straight lateral margins and slightly incurvate apices; cerci three times as long as their greatest width. Aedeagus short. Epiphallus with wide, slightly curved arcus and with well-developed bulbi; cornua bent slightly outwards; lobi papillati with two triangular outgrowths. General pigmentation olive-green. Occiput and pronotum with two blackish longitudinal lateral bands which usually extend on to the abdomen. Tegmina red. Furculae of last abdominal tergite, lateral margins of anal plate and teeth on paraprocts black. Hind tibiae reddish, yellowish in the basal third.

♀. Like the male but larger. Antennae shorter than head and pronotum combined; median segments almost square or barely oblong; length of each median segment usually equal to its maximum width, sometimes slightly longer to a quarter longer than it, rarely half as long again; apical segments usually transverse; length of each individual apical segment less than its greatest width. Pronotum short, greatly widened towards posterior margin, posteriorly covered with coarse, shallow punctures; anterior and median transverse striae not pronounced. Maximum width of prothoracic tubercle conspicuously greater than its height. Space between lateral lobes of mesothorax very wide, its maximum width clearly exceeding the minimum width of the lateral mesothoracic lobe. Space between lateral lobes of metathorax very wide, its maximum width being four times its length. Posterior margin of genital plate with a sharp median projection, on each side of which there is a rounded excavation. Ovipositor sheaths with a distinct arcuate excavation terminally. Pigmentation as in males. Apex of genital plate with two lateral black spots.

Length: body ♂ 14.0-15.0, ♀ 17.0-18.0 mm; antennae, ♂ 5.5-6.5, ♀ 4.8-5.3; pronotum, ♂ 3.1-3.5, ♀ 3.8-4.2; elytra, ♂ 0.8-1.2, ♀ 0.8-1.8; hind femora, ♂ 8.2-8.9, ♀ 9.9-10.5 mm.



Figs. 1 - 6: Odontopodisma carpathica Kis, sp.n. 1 - Head and pronotum from above, ♀, allotype; 2 - left elytron, ♀, allotype; 3 - apex of abdomen from above and left-hand cercus from the side, ♂, holotype; 4 - copulatory apparatus from above, ♂, holotype; 5 - prothoracic projection, from in front, ♀, allotype; 6 - apex of abdomen, from below, ♀, allotype.

Distribution: Rumanian People's Republic, South Carpathians, Poiana Spinului at the summit of Mt. Cozia, 19 August 1959, 6 ♂ (including holotype), 8 ♀, 1 ♂ larva and 1 ♀ larva (Bela Kish).

Collected from Vaccinium myrtillus L. at 1671 m.

Odontopodisma carpathica Kis. sp. n. is easily distinguished from all other species of the genus Odontopodisma Dov.-Zap. by the shorter and thicker antennae, the very wide prothoracic projection, the very short elytra, not covering the tympanal organ, in both sexes, the glabrous

anal plate in the male, the structure of the male reproductive apparatus, and the posterior margin of the genital plate in the female with its very narrow, acuminate median projection with two rounded excavations laterally (Figs. 1-6). In all other species of this genus the antennae in both sexes are longer and more slender, the prothoracic projection in both sexes is narrower, the elytra in both sexes are more strongly developed and completely cover the tympanal organ (Baccetti, 1958: 305-307, Fig. V), the anal plate in the male has its raised projections of various shapes; the structure of the male reproductive apparatus and of the posterior margin of the genital plate in the female is quite different from that in the known species (Ramme, 1951, Abb. 4, 8, 9; Mishchenko, 1952: 359-365, Figs. 406a-406e, 407; Harz, 1957: 298-300, Abb. 166). The species most resembles O. fallax Rme., from which it differs not only in regard to the above-mentioned characters but also by the even shorter and wider cerci in the male. In O. fallax Rme. the male cerci are longer and more slender (Ramme, 1951, Abb. 5f).

Apart from O. carpathica Kis, sp. n., two other species of the genus Odontopodisma Dov.-Zap. occur in Rumania (Ramme, 1951: 46-47, 50-51, 54; Mishchenko, 1952: 361-365; Knechtel and Popovici-Biznoseanu, 1959: 180-182): O. decipiens Rme., which infests plains and hilly places and O. schmidti (Fieb.), which occurs on hills at a height of 700-800 m.

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NEW SPECIES OF THE GENUS LATHRIMAEUM (COLEOPTERA, STAPHYLINIDAE) FROM CENTRAL ASIA

J. D. KIRSCHENBLAT

Lathrimaeum mesasiaticum Kirschenblat, sp. n.

Pitch-black, shining, palpi and legs dark red-brown; sometimes the lateral margins of the pronotum and elytra and the apex of the abdomen narrowly are translucent, becoming reddish.

Head transversely oval, with bulging eyes, a little narrower than the pronotum at its anterior margin. Longitudinal diameter of compound eyes much greater than the length of the temples. Behind the eyes the temples are slightly dilated as far as the fine occipital carina, and then slope abruptly towards the cervical constriction. Ocelli set a little farther apart from one another than from the compound eyes are triangular and extend forward in the form of broad, flat frontal furrows. The median part of the head between these furrows is convex and more shiny. Vertex sometimes with a slight horseshoe-shaped depression. Top of head covered with fairly fine and comparatively dense punctation. Punctation sparser or almost lacking on anterior part of frons. Antennae well proportioned, segments from the third onwards covered with a dense pubescence forming a border; their length slightly greater than length of head and pronotum combined. First antennal segment long, apically clavate; second segment thickened, oval; third segment flattened, with a narrow base, evenly dilated apically, of the same length as the second segment; fourth, fifth and sixth segments slightly shorter than the third and almost equal to one another in length; seventh segment slightly, and eight segment a good deal, shorter than the preceding segments; ninth to eleventh segments much wider, forming a 3-segmented but not very pronounced club, ninth segment almost quadrate, tenth slightly transverse, eleventh acuminately ovate, almost twice as long as the tenth.

Pronotum slightly narrower than base of elytra, half as long again as its width. Anterior pronotal margin with a very weak groove on each side, its center almost at the same level as the broadly rounded and not prominent anterior angles. Lateral pronotal margins evenly rounded, with very thin border. Posterior angles rounded. Posterior pronotal margin convex, with a very delicate groove on each side. Center of pronotum convex, but its sides impressed and flattened over a wide area. There is a narrow and shallow longitudinal impression on the anterior half of the pronotal disc along the median line and there are two deeper oval impressions, which together form a horseshoe-shaped pit, in the posterior half; these oval impressions are almost joined at their anterior margin to shallower impressions situated in the middle of the lateral margin of the pronotum. Pronotal surface covered with fairly fine, dense punctation, spaces between the punctures equal to or slightly smaller than the diameter of the punctures.

Elytra more than twice as long as pronotum, slightly broadened posteriorly, flattened above, with narrow lateral margins, with a longitudinal impression along almost the entire length of the suture and with a barely perceptible hint of longitudinal furrows on the disc. Sutural angles narrowly rounded, producing a long acute-angled excision, through which the folded wings are visible, between the elytra. External angles of elytra rounded. Surface of elytra covered with a dense but comparatively fine punctation, forming slight transverse rugulae, and with a very short, fine fringe of hairs. Longitudinal spaces between punctures approximately equal to the diameter of the punctures, transverse spaces much smaller than diameter of punctures.

Abdomen oval, with broadly flattened lateral margins and acuminate apex and covered with a fine and moderately dense punctation and very short dark hairs, with fine shagreening between the punctures.

Legs comparatively well-proportioned, tibiae covered with serveral rows of small spines.

♂ unknown.

Length 2.7-3.2 mm.

Distribution. Tadzhikistan: Stalinabad, 28 October 1943 (Kirichenko), 1 ♀ (holotype); Pendzhikent, 10 December 1943 (Kirichenko), 1 ♀. Uzbekistan: Golodnaya steppe station, 5 April 1903, (Jacobson), 1 ♀.

Type and paratypes in collections of the Institute of Zoology, Academy of Sciences, USSR.

The species is most closely related to Lathrimaeum fusculum Er., from which it is readily distinguished by the longer elytra, the finer and denser punctation of the pronotum and elytra and many other characters.

A NEW SPECIES OF THE GENUS SARATHROPUS ER. (COLEOPTERA, TENEBRIONIDAE) FROM CENTRAL ASIA

G. S. MEDVEDEV

While studying material of the genus Sarathropus in the Institute of Zoology (Academy of Sciences, USSR) collection we discovered some hitherto unknown species, which are described below.

Sarathropus fallax G. Medvedev, sp. n.

Very similar to Sarathropus depressus Zoubk. Body blattened, black. Frons convex medially, concave laterally. Supra-ocular carinae high but blunt, extending well forward beyond margin of eyes. Genae with parallel sides in front of eyes, then forming a blunt obtuse angle and narrowing towards apex of clypeus. Clypeal sutures fine. Anterior margin of clypeus broadly and not deeply excavated. Antennae slender, almost reaching the base of the pronotum; scape thickened, second segment short, its length equal to its width, third segment slightly shorter than fourth and fifth combined. Last four segments conspicuously flattened; ninth segment widest, triangular, with an area densely covered with short yellowish hairs apically on the inner and on the outer sides; tenth segment shorter than ninth, areas covered with yellowish hairs larger; last segment slightly longer than tenth, gradually becoming acuminate apically, and except for the basal part entirely covered with yellowish hairs. Mentum slightly transverse, narrowing slightly forward, glabrous, with a triangular excision on anterior margin. Pronotum widest before middle. Distances between apices of anterior angles smaller than between apices of posterior angles. Lateral margin rounded in the anterior two-thirds, narrowed and more straight-sided in the posterior third. Anterior and posterior angles acuminate, strongly protruding. Each interior margin of the anterior angles bears a tuft of setae. Anterior margin medially almost straight, posterior margin arcuate. Spreading lateral margins relatively broad, conspicuously upturned their upper surface usually slightly rugulose. Elytra oblong-ovate, widest medially. Humeral and lateral carinae sharp throughout their length. Surface of elytra flattened between humeral carinae but slightly convex along the suture. Apical declivity steep. Upper and under sides of body entirely covered with very fine punctation. Legs relatively short. Tibiae (especially the front tibiae) apically enlarged, conspicuously curved. Tarsi above covered with light setae; distal margins of last segments bearing very long setae which cover the claws above. Claws long, slightly curved, acuminate. Length ♂ ♀ 14-20 mm, width 6.3-8.5 mm.

The species described differs sharply from S. depressus Zoubk. in regard to the structure of the male genitalia. In S. fallax sp. n. (Figs. 1 and 2) the parameres are acuminate apically; the cone-shaped tube enclosing the apex of the penis is raised slightly above the surface of the parameres and not visible laterally; the lower surface of the parameres is impressed throughout its length; in the distal part this impression becomes a furrow. In S. depressus Zoubk. (Figs. 3 and 4) the apical part of the parameres is widened spearhead-like; the cone-shaped tube is easily visible from the side; the lower surface of the parameres is slightly convex, but has a barely perceptible median impression in the distal part.

A combination of external characters further differentiates the two species. In S. fallax sp. n. the pronotum usually has wider spreading lateral margins, which are more sharply separated from the central part of the pronotum. The posterior angles of the pronotum in S. fallax sp. n. protrude more strongly caudad. The elytra are very often slightly convex along the suture whereas in S. depressus Zoubk. they are almost invariably flat here. In S. fallax sp. n. the humeral carinae on the apical declivity of the elytra are sharp, whereas in S. depressus Zoubk. they are conspicuously weak in this part.

In the Institute's collection the species is represented by extensive series from the Kzyl-Orda province, Kazakhstan (Tartugay-Zhulek-Baygakum district) and from Tamda-Bulak in the Bukhara province of Uzbekistan. In addition, there are specimens from the Muyumkum sands and from the southern shore of Lake Balkhash (estuary of the Karatal River). Collected in May-July.

Holotype: ♂, Kazakhstan, Zhulek (on old maps—Dzhulek) 15 July 1910 (V. Kozhanchikov). Paratypes: Ibid, 1-16 July 1910 (V. Kozhanchikov), 32 specimens, ♂, ♀.

The species was previously confused with the related S. depressus Zoubk., which occurs mainly in the sandy deserts of Turkmenia and the south of the Bukhara province of Uzbekistan. In the Institute's collection it is represented by specimens from the following places: Uzun-Ada, Dzhebel, Molla-Kara, the Orta-Kuyu Well, Uch-Adzhi, Repetek, Farab, Bagaabzal' (north of Bukhara). One specimen bears the label "Sefir-Kuh, Kuschke, Hauser"; it was evidently such specimens that gave grounds for indicating Afghanistan as the place of origin of S. depressus Zoubk.

Sarathropus kiritshenkoi, G. Medvedev, sp. n.

As regard the structure of the male genitalia this species resembles S. fallax sp. n. The parameres are apically acuminate, not widened spearhead-like, but the cone-shaped tube enclosing the apex of the penis can be seen easily in lateral view, the parameres are more strongly curved and the basal part of the genitalia is thicker.

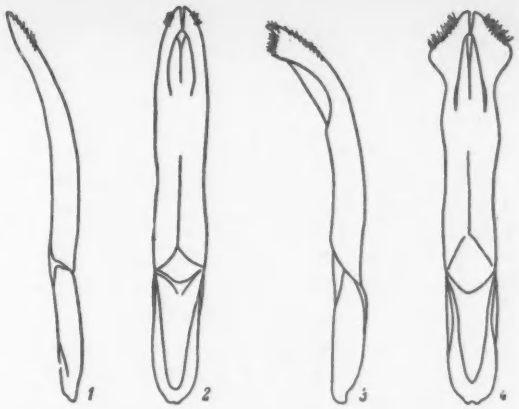
The external shape of this species is quite characteristic. The specimens at our disposal are distinguished by their large size. The pronotum has very wide lateral margins, its anterior and particularly its posterior, angles are conspicuously more protuberant than in S. depressus Zoubk. and S. fallax sp. n. The humeral and lateral carinae on the elytra are high and sharp throughout their length, the surface of the elytra between the humeral carinae being canalicular. The narrow part of the elytral surface between the humeral and lateral carinae is concave, whereas in S. depressus Zoubk. and S. fallax sp. n. it is flat and the carinae demarcating it are not raised above it at all. This character clearly distinguishes the species from other representatives of the genus Sarathropus. Length 18-22 mm, width 8-9.2mm.

Holotype: ♂, Uzbekistan, Termez, 19 April 1912 (A. N. Kirichenko).

Allotype: ♀, Turkmenia, Mukry, 13 June 1904 (G. Suborov).

Paratypes: 2 ♀♀, Tadzhikistan, "vicinity of Stalinabad" (probably sand, south of Stalinabad) 10 May 1956.

S. kiritshenkoi sp. n. was found well to the south of the



Figs. 1 - 4: 1 - Sarathropus fallax, sp.n., ♂, genitalia, lateral view; 2 - the same, dorsal view; 3 - Sarathropus depressus Zoubk., ♂, genitalia, lateral view; 4 - the same, dorsal view.

S. fallax sp. n. area. The boundary for S. depressus Zoubk., which occupies a fairly isolated position in the genus Sarathropus, runs a good deal nearer to the S. fallax area in the west and northwest; this species therefore separates the distribution areas of the more nearly related species S. fallax sp. n. and S. kiritshenkoi sp. n.

The types of the species described are preserved in the Leningrad collection of the Institute of Zoology (Academy of Sciences, USSR).

In conclusion it must be pointed out that the genus Sarathropus is very closely related to the genus Cyphogenia. Both genera differ from other representatives of the tribe Akidina in having a peculiar structural arrangement connecting the prothorax firmly to the hind part of the body. In particular, the propleura have a C-shaped prominence on each side of their interior walls. The outer ring of this prominence protrudes beyond the margin of the propleura in the form of a tooth. In contrast, the anterior external angle of the thoracic episternum forms a C-shaped groove, widened towards the bottom. The protuberances fit tightly into the grooves on the corresponding sides. Movement of the pronotum is strictly limited to one vertical plane. This structural arrangement is directly connected with the beetles' habit of infesting deep cracks and narrow crannies which serve them as hiding places. Most representatives of the genus Cyphogenia prefer compact soils whereas all species of Sarathropus live in sand. The specialized adaptations of Sarathropus life in sand are the strong development of setae on the tarsal segments and the extreme flattening of the body, which enables the beetle to penetrate into the cracks of mounds near saxoul and various other shrubs. In addition each of the anterior angles of the pronotum bears a tuft of setae interiorly opposite the compound eyes, with which the insect wipes particles of the substrate from its eyes. The strong development of the anterior pronotal angles is connected with protection of the eyes. These features, together with the development of setae for cleaning the eyes are peculiar to many swarming Tenebrionidae, particularly the psammophilic types. It is characteristic that in S. depressus Zoubk. one observes a tendency for the posterior angles of the pronotum alone to diminish.

We see that the genus Sarathropus has become differentiated from Cyphogenia as a result of progressive specialization for life in sandy deserts. Of the three species of the genus, S. fallax, sp. n. and S. kiritshshenkoi, sp. n. diverge less from the type characteristic of Cyphogenia as regards both external appearance and genital structure whereas in S. depressus Zoubk. the adaptational characters are more strongly developed.

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A NEW SPECIES OF DIESIA FISCH.-W. (COLEOPTERA, TENEBRIONIDAE)

A. V. BOGACHEV

Diesia (s. str.) argentata A. Bog., sp. nov.

The species is readily distinguished by the characteristic short silvery-gray pubescence covering the whole body and missing only along the dorsal suture of the elytra. In size, shape of body and silvery-gray pubescence it greatly resembles Diesia iduna (Reitt.)[1], which lives in sands near the river Ili in eastern Kazakhstan, but differs from that species in the structure of the fore tibiae (in D. iduna the apical tooth is more pronounced, the tibiae are more enlarged apically and the teeth on the outer margin are smaller and less sharp). The last antennal segment in D. iduna (Reitt.) is not lengthened and the pubescence is less thick.

The head is small. There are fairly large punctures, separated medially by a gray pubescence, on frons and vertex. The clypeus is bare, shining, with sparser punctures and almost squarely truncate anteriorly. The labrum is large, with sparse punctures and with dense setae anteriorly. The compound eyes are reniform and slightly convex. The antennae are slender, reaching the bases of the elytra, brown, covered with fine hairs, individual longer hairs at the apices and exserted long slender setae on the two penultimate segments. The third segment is long, equal to the three following segments combined and nine to ten times longer than its width; the next (4th-6th) segments are long, three to four times longer than their own width; the ninth is darker, triangular and twice as long as its width; the tenth is short, wide, transverse and wider than the others in the male; the eleventh is in the shape of an acute-angled triangle, strongly acuminate, equal in length to the two preceding segments combined, light yellow; in the female the tenth segment is not so broad and the eleventh shorter than in the male, conical and slightly longer than the tenth. The submentum is transverse, laterally rounded, with an anterior cleft, scattered punctures and exserted hairs.

The pronotum is transverse, 1.8 times as wide as it is long, with an almost straight anterior margin, sharp, projecting anterior angles, very slightly rounded lateral margins and blunt posterior angles. The posterior margin has a shallow, broad notch medially. The margins are bordered, the border of the anterior margin being medially smooth. The pronotum is almost evenly covered with small granules and has a smooth stria along the anterior and posterior margins, with thick adjacent grey pubescence. The propleura are still more thickly pubescent, with sparse granules.

The elytra are almost straight across base but have prominent humeri, are 1.6 times as long as wide, and have slightly rounded sides; they narrow conspicuously from three-quarters of their length to the apex. The humeral carina is sharp and somewhat serrate (the teeth are sparser and larger around the shoulders). The dorsum is slightly convex transversely. Two very pronounced primary longitudinal rows of granules run along the dorsum of each elytron, disappearing before the apex. In each of the spaces between these primary rows, the suture and the humeral carina a longitudinal row of granules, not so dense as the primary rows, can be observed. These secondary rows are less regular; sometimes there are isolated additional granules scattered in a row along with them. The pseudepipleura are densely pubescent, separated by a slender, slightly curved lateral margin which is invisible from above because of the humeral carina. The elytra are covered with erect gray-brown hairs and appressed gray pubescence on the dorsum. The prosternum projects a short distance beyond the coxae; the mesonotum is convex, the abdomen densely pubescent with small granules.

Legs slender, long. Femora narrow, densely granulose. Anterior tibiae fairly narrow, slightly enlarged apically, with a narrow sharp apical tooth, two long spurs, and 7-9 sharp narrow teeth on the outer margin, along with long, not dense brownish hairs. Median and posterior tibiae with slender spines and long, denser, brownish or golden hairs posteriorly and fairly long spurs. Hind tarsi conspicuously flattened, anterior and median tarsi slightly flattened laterally, with dense long golden or brownish hairs on either side. Claws long, slender, slightly curved.

Length ♂ ♀ 18-21 mm, width 8.3-10 mm.

Distribution: Dosang (north of Astrakhan), in gerbil holes, in sandy clay 3-6 January 1938 (Karpushev, 2 ♂, 2 ♀ in author's collection); sands in Nogay steppes (from V. N. Luchnik 1 ♂ in author's collection). Western Kazakhstan, sands, 40 km west of Novo-Bogatinskoye, Gur'yev Province, 27 May 1952 (L. Arnol'di, 10 ♂ ♀, including holotype, in the collection of the Institute of Zoology, Academy of Sciences, USSR). Dengiz District, Gur'yev Province, 1930 (Borman, 1 ♂ in collection of Institute of Zoology, Academy of Sciences, USSR).

The species occurs in barkhan sands, is active after sunset (until roughly midnight) and has been collected in winter in sandstone holes.

These darkling beetles emit a characteristic quiet chirping noise, like that of grasshoppers, which they make by rubbing the hind tibiae against the serrated humeral carinae of the elytra, at the same time raising the abdomen and standing on the two front pairs of legs.

This is the most northern and western representative of the genus Diesia Fisch. (s. str.). Other species are known from the deserts of Turkmenia, Uzbekistan and Tadzhikistan. (D. sexdentata Fisch.-W., D. quadridentata Fisch.-W. and D. sefirana Reitt.) and eastern Kazakhstan (D. iduna Reitt.).

[1] D. iduna Reitt. has been described as a representative of the genus Sternoplax but should be re-keyed to the genus Diesia.

LARVAE OF DARKLING BEETLES OF THE SUBFAMILY PIMELIINAE (COLEOPTERA, TENEBRIONIDAE) FROM WESTERN KAZAKHSTAN

S. I. KELEYNIKOVA

The subfamily Pimeliinae (Jacobson) is one of the four subfamilies of darkling beetles the species of which infest arctic deserts and arid regions, while the larvae develop in the soil. In the present paper we examine the larvae of species from both tribes of this subfamily, the Pimeliini and the Platyopini. The soil-inhabiting larvae of darkling beetles occur in large quantities and injure agricultural crops in the arid regions of the USSR (Berezina, 1949; Gilyarov, 1952; Znamenskiy, 1952). The existing keys for the Soviet fauna in these tribes include only one species, Pimelia subglobosa Pall. (Ogloblin and Kolobova, 1927; Savchenko, 1937; Il'inskiy, 1948; Gilyarov, 1952). The distinguishing characters adduced for Pimelia subglobosa Pall. are common to all other species of these two tribes; in other words they characterize the tribes as a whole.

In the present paper we shall describe the larvae of: Pimelia subglobosa Pall., Pimelia capito Kryn., Platyope leucogramma Pall., Trigonoscelis muricata Pall. and Diesia argentata Bog. A key is provided. We have employed those characters which in our opinion can be used for diagnosis. An attempt was made to introduce a new diagnostic character, the shape of the tormae (sclerites for raising and lowering the labrum) which has not been previously used in diagnosing the larvae. It was found that the shape of these sclerites was specific for each species of the larvae reviewed, a phenomenon evidently connected with trophic specialization. The leg setation is described in detail. We have adopted the system of dividing the leg into coxa, trochanter, femur, tibia and tarsus.

The larva of Pimelia subglobosa Pall. has been described in particular detail as this species is the most widespread and commonly encountered. In describing the other species we have noted in particular characters differentiating them from Pimelia subglobosa Pall. The larval descriptions are not arranged in systematic order.

MATERIAL AND METHODS

The material was collected in 1951-1952 in the area between the Volga and Ural Rivers (Provinces of Western Kazakhstan and Gur'yev). The larvae were scalded in boiling water and kept in 70° in alcohol. The larval species were identified by discovering the compostion of the imago population in the given locality and checked by comparison with other material.

Larvae of Pimelia subglobosa Pall. were collected at the Dzhanybek station (Western Kazakhstan) of the Institute of Forestry (Academy of Sciences, USSR). Apart from this species neither imagos nor larvae of any other representatives of the tribe Pimeliini were discovered at the Dzhanybek station. Entomological collections have been made at the station for a number of years and were examined by us.

Larvae of Pimelia capito Kryn. were collected in sandy loam soils in plantations near Mt. B. Bogdo (Astrakhan province); the only Pimeliinae imagos found there were Pimelia capito Krin. and Platyope leucogramma Pall. The larvae of the last-named species were already known to us from the sandy steppes in the neighborhood of Yanvartsevo, West Kazakhstan.

We found imagos and larvae of Diesia argentata Bog. in broken down barkhan sands in the Novo-Bogadinsk area, Gur'yev province. Diesia argentata Bog., like Trigonoscelis muricata Pall., is the sole representative of its genus in the interfluvial plain. The imago and larvae of the latter species were found in fixed hummocky sands near the settlements of Tas and Yeltay, Gur'yev province.

No special treatment of the material is required in order to study the characters described below. Parts of the mouth apparatus were examined in glycerine under a glass cover.

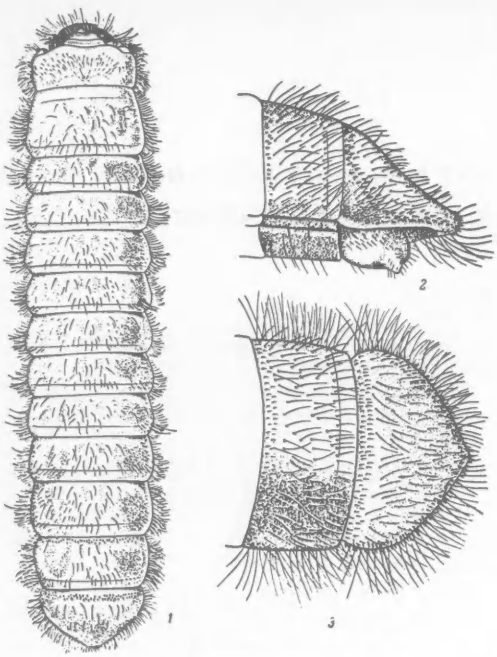
Pimelia subglobosa Pall. (Fig. 1).

The longest of the larvae examined measured 30 mm. The larva is broad and flattened. Length to width ratio 4:1. Color pale yellow, whole body covered with short golden hairs. Posterior marginal borders of segments free from hairs.

Head three and one half times wider than long. First antennal segment one third longer than the second. Two ocelli on each side, the front one represented by one pale pigmented patch and the second by two. Borders of hairs and setae on head margins. Head capsule above covered with sparse short hairs and coarsely shagreened, except for two symmetrical patches at the base of the capsule and bands running from these to the second ocellus. These parts of the surface are glabrous. In all Pimelia larvae known to us the surface of the head capsule has this appearance. Labrum transverse, its width three times its length. Dorsally (Fig. 5) the whole anterior margin and the sides as far as the middle are bordered with a wide uneven band of very long setae. Medially, across the labrum there is a band of similar setae. The marginal and median bands join to form a closed ring. There is one small spine on each side of the median bare space. The lower surface bears bands instead of a row of stout setae along the lateral margins. As these bands approach the anterior margin they curve into the disc and break off, the setae here becoming thicker. The epipharynx is covered with scale-like setae. A space free from setae traverses the epipharynx medially from front to back, dividing it into two halves; it contains six small paired spines. In the middle of the posterior epipharyngeal margin are two large spines. The paired sclerites (tormae) situated between the clypeus and the labrum are short and wide and lie at an angle to one another. Anteriorly each torma has two weak teeth; posteriorly they are entire (Fig. 4). The labrum has the usual structure found in Tenebrionidae larvae; ligula bearing six setae.

Mandibles (Fig. 6). Length to width ratio 3:2. The excision occupies more than half the length of the mandible; there is one apical and one preapical tooth. Maxillae (Fig. 7) as typical of Tenebrionidae. Clypeus almost twice as wide as long, with long, close-set setae on posterior margin.

Segments. First thoracic segment half as long as wide and twice as long as each of the next two thoracic segments. Anterior margin of its tergite with a border similar to that on the posterior margin. Second and third thoracic segments a quarter as long as they are wide. Except for the eighth and ninth the abdominal segments are one third as long as they are wide. Length to width ratio of eighth segment 2:5; small spines along its anterior margin. Ninth segment curved, length to width ratio 1:2; its tergal surface

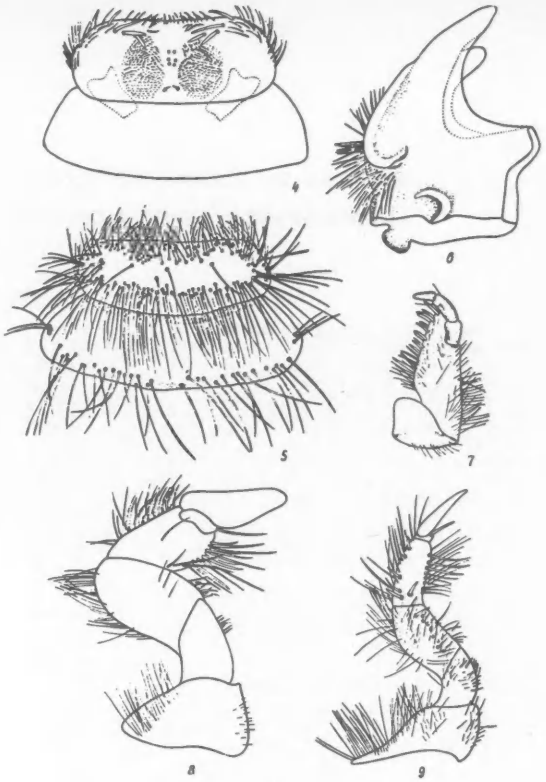


Figs. 1 - 3: Pimelia subglobosa Pall., larva. 1 - dorsal view; 2 - 8th and 9th segments laterally; 3 - the same, dorsal view.

obliquely truncate. The entire segment surrounded on the outside by short thick spines, set in two, three or four rows. The pygopods of the 10th segment and the lateral margins of the ninth sternite bear stout spinelets set in two or three rows (Figs. 2,3).

Legs. First pair (Fig. 8). Tarsus with a broad, short, powerful claw. One seta at base of claw on inside, reaching halfway along the length of the claw; seta on dorsal side barely perceptible. A double-row comb of stout setae on tibiae, inside; a similar row of weaker setae on the outside. Femora with long, slender setae on the outside. A cluster of stout setae on the inside. Four to five stout spinelets and several slender setae on the inside of the trochanter, apically. On the outside a small patch of slender setae. Two bands of setae on the outer edge of the coxa. Second and third pairs (Fig. 9). Tarsus with a long sturdy claw. Basally on the inside, a long seta; a second one dorsally, very small. Tibia with a comb of eight or nine sturdy setae on the inside and slender setae arranged in a fairly compact row on the outside; four or five spines on the transition to the dorsal surface, set in a sparse row. On the dorsal surface, nearer the base, a sturdy spine. Dorsal surface of tibia free from hairs. On the inner surface the femur has a flattened area defined anteriorly by a row of finer and posteriorly by a row of stouter setae (from six to nine). At the distal extremity of this platform, almost medially, there is sometimes one isolated spinelet. The posterior and anterior sides covered with hairs. The femoral platform extends to the trochanter, being defined along its interior surface, anteriorly and posteriorly, by spinelets and setae. The remaining surfaces of the trochanter are covered with setae and hairs. The coxa is entirely covered with slender setae, except for its outer surface, which is convex and glabrous.

Pimelia subglobosa—a typical steppe and Mediterranean species, which in the area between the Volga and the Ural extends far south, to the semi-desert. Its southernmost point of occurrence in this area is Azgir in the province of Western Kazakhstan. The larvae have been found at shallow depths (10-15 cm) among plant roots. Most of the larval collection is from the vicinity of the Dzhanybek station in Western Kazakhstan. In addition we have used L. Zinov'yev's collections from the right bank of the Volga River (settlements of Yenotayevka and Nikol'skiy). Twelve larvae



Figs. 4 - 9: Pimelia subglobosa Pall., larva. 4 - Labrum and clypeus from below; 5 - the same, from above; 6 - mandible; 7 - maxilla; 8 - first pair of legs; 9 - second pair of legs.

were examined.

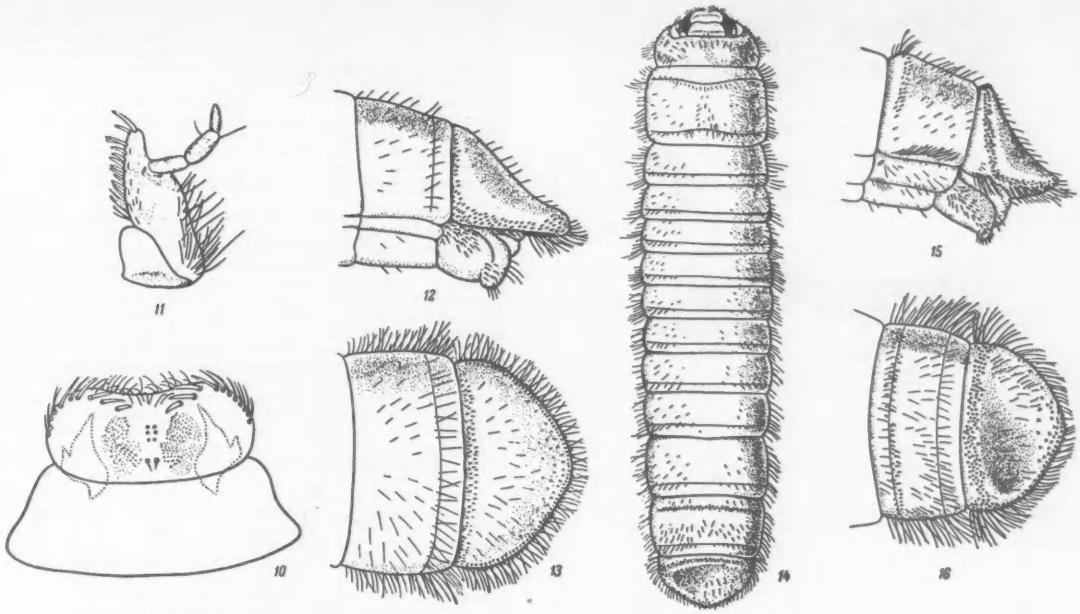
Pimelia capito Kryn.

Maximum length of larvae examined 25 mm. In outward appearance the larvae are very similar to those of P. subglobosa but differ a good deal from the latter in a number of characters. The P. capito larva is much less hirsute; the hairs dorsally on the tergites are slender and sparse, covering mainly the postero-marginal borders.

Head three times wider than long. First antennal segment twice as long as second. Labrum narrower than in P. subglobosa; two to three times as broad as long (length-width ratio 43:113). The vestiture of the external labral surface is similar. On the inner surface the setae form two semicircles with their apices turned forward (Fig. 10). Each semicircle is formed of an equal row of eleven to twelve setae. For the rest, the inner surface is similar to that of P. subglobosa.

Mandibles: length to width ratio 4:3; excision occupies half the length of the mandibles. Labium as in P. subglobosa but ligula furnished with five setae. Maxillae: first segment of palp articulated to masticatory lobes (lacinia + galea) instead of to stipes as in most darkling beetles, forming a right angle with the lobe (Fig. 11). Clypeus: almost two-thirds wider than long, with long setae set densely on posterior margin. Shape of tormae different from that found in P. subglobosa (Fig. 10).

Segments. Ratio of segment sizes the same as in P. subglobosa. Eighth tergite without spines on anterior margin. Ninth segment in general similar to that of P. subglobosa except that the apex extends somewhat farther down



Figs. 10 - 13: Pimelia capito Kryn., larva. 10 - Labrum and clypeus viewed from below; 11 - maxilla; 12 - 8th and 9th segments, lateral view; 13 - the same, dorsal view; Figs. 14 - 16: Platyope leucogramma Pall., larva. 14 - general shape viewed from above; 15 - 8th and 9th segments, laterally; 16 - the same, dorsally.

and the spinelets are particularly dense (Figs. 12, 13).

Legs: Armature as in P. subglobosa.

The species is peculiar to the compacted sands of grass and wormwood deserts and to rather saline sands with desert thistle associations (Bogdinsk settlement; a point to the west of Novyy Ushtagan, West Kazakhstan). Larvae among plant roots at a depth of 10-15 cm.

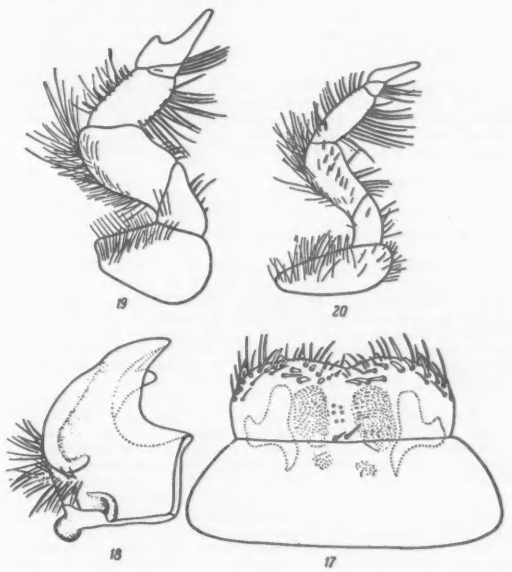
Eighteen grubs were examined.

Platyope leucogramma Pall.[1] (Fig. 14).

Maximum length of larvae examined 27 mm. The grub is flattened, length to width ratio being 27:5. Integument uniform, pale yellow, shining, glossy. Hairs sparse above on tergites, denser on the sides. Postero-marginal borders do not differ in color from tergites and are demarcated from them by a small row of sparse hairs.

Head. Length to width ratio 3:8. Ocelli lacking in adult grubs; in the younger instars there are ocelli in the form of two almost fused pigmented patches at the base of the antennae. Length of first antennal segment almost twice that of the second (17.9). Surface of head capsule dorsally as in P. subglobosa. Labrum transverse, three times as wide as long. A large excavation on anterior margin. Armature of outer and inner surfaces as in P. subglobosa but shape of tormae different (Fig. 17). Labium of the type characteristic of darkling beetles; ligula equipped with two setae. Mandibles (Fig. 18): length to width ratio 3:2; excision occupies half the length of the mandible. Only apical and preapical teeth present, median tooth lacking. Maxillae characteristic of darkling beetles. Clypeus almost three times as wide as long (9:25); long setae on posterior margin; a small darker patch medially on posterior margin.

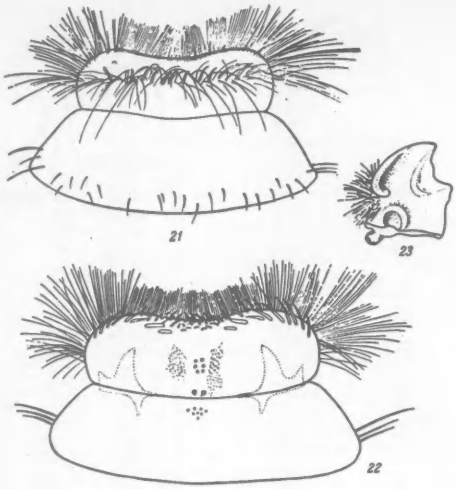
Segments. First thoracic segment twice as long as each of the next two segments and two-thirds as long as its own width. Anterior margin of tergite with a border similar to that of posterior margin. Second and third thoracic segments one-third as long as they are wide. First to sixth abdominal segments two-fifths as long as they are wide. In the fourth and sixth segments the posterior margin of the sternite is raised and the angles extended to form small appendages.



Figs. 17 - 20: Platyope leucogramma Pall., larva. 17 - labrum and clypeus viewed from below; 18 - mandible; 19 - first pair of legs; 20 - second pair of legs.

Seventh and eighth segments slightly narrower and longer than the preceding ones. Eighth tergite covered with small spines on anterior margin. Ninth segment rounded, apically, length to width ratio (4:7.5). Tergite obliquely truncate and surrounded by a border of very short and very thick spinelets. Sternite of ninth segment with bands of spines on lateral margins. Pygopods of tenth segment small and covered with two or three rows of short spinelets (Fig. 15,

[1] As a description of the P. leucogramma Pall. larva has already been given by Skapine (1959) we have confined ourselves here to giving a brief comparative description.



Figs 21 - 23: Diesia argentata Bog., larva. 21 - Labrum and clypeus from above; 22 - the same, from below; 23 - mandible.

16).

Legs. First pair (Fig. 19) bears a broad, strong bidentate claw. Tarsus bears a thick comb of ten to twelve setae on the inside; otherwise the structure and armature of the legs are the same as in P. subglobosa, except that there are fewer hairs. Second and third pairs of legs (Fig. 20) have similar armature. Tarsus equipped with a comb of four to six setae. General pattern of armature otherwise the same as in P. subglobosa.

The species is peculiar to sandy Sheep's Fescue and feather grass steppe, and sandy grass and wormwood desert; West Kazakhstan province, settlement of Yanvartsevo, north of the settlement of Mykhorskiy, Urda, northwest of Azgir; Novyy Ushtagan; Gur'yev province, Tash settlement.

Twenty grubs examined.

Diesia argentata Bog.

Maximum length of larvae examined 35 mm. Body broad, flattened. Length five to six times its width. The grub is light-colored (pale yellow) with glossy shiny surface. Posterior marginal borders of all segments with spare longitudinal striations and lighter hue, although the difference in color is barely perceptible. Under side of head and the thoracic sternites densely covered with long, slender golden hairs.

Head bears bands of short stout setae dorsally on margins. Head capsule one-third as long as its width. First antennal segment twice as long as second; ocelli lacking. Labrum transverse (three and a half times as wide as it is long); a wide excavation anteriorly; dorsally the whole anterior margin and the sides as far as the middle are bordered with a broad band of long slender hairs; medially the labrum is transversely raised and also bears a wide band of long slender hairs, among which are short, flat setae. Reaching the margins of the disc, the median band fuses with the ends of the "marginal" bands. On the bare space of the disc bordered with hairs there is one short, stout spinelet on each margin. Epipharyngeal surface anteriorly (in the excavation) set with short, slightly retrorse setae. Two very even rows of nine to ten long chaetae at the anterior-lateral margin of the epipharyngeal surface; on reaching the excavation these rows turn slightly inward and are interrupted without joining each other; the chaetae nearest the break are the thickest. Epipharynx with six small spines medially, paired in two rows. Spinelets of first and second pairs approximated. On posterior margin of spipharynx, two stout spines. Mandibles square, excision shallow, extremities comparatively blunt (Fig. 23). Only the two apical teeth are well developed. Only the anterior part of the mandible is strongly sclerotized. Band of setae wide dorsally (one third its length). Maxillae of usual type. Labium of usual type. Proximal part of submentum covered with slender setae. Submentum bears two groups of setae under the palps; first segment of palp covered with long setae. Ligula bears two long setae. Clypeus transverse, three and a half times as wide as it is long. Sixteen to twenty recurvate setae on posterior margin. Three long setae on each side of the clypeus, extending slightly in front of to posterior margin and set close together. Tormae have four spines, two of them sharp and antrorse, one introrse and the other retrorse (Fig. 22).

Segments. First thoracic segment two and a half times longer than the head and twice as long as each of the remaining thoracic segments (second and third); anterior margin of its tergite has a border with sparse longitudinal striation. Abdominal spiracles oval. First two abdominal segments equal to each other, their lengths one third of their widths. From the third segment onwards the length gradually increases and in the fourth segment it is half the width. Ninth abdominal segment half as long as it is wide, broadly rounded, convex dorsally; there is a small flat rim on the margin, terminally thickened and bent slightly downwards. The margins of the tergite are set with very short thick spinelets, arranged in the form of a triangle. Pygopods only very slightly protruding. Ninth sternite bears small spines on margins, set in a row and running across to the lobes of the penis (Figs. 24, 25).

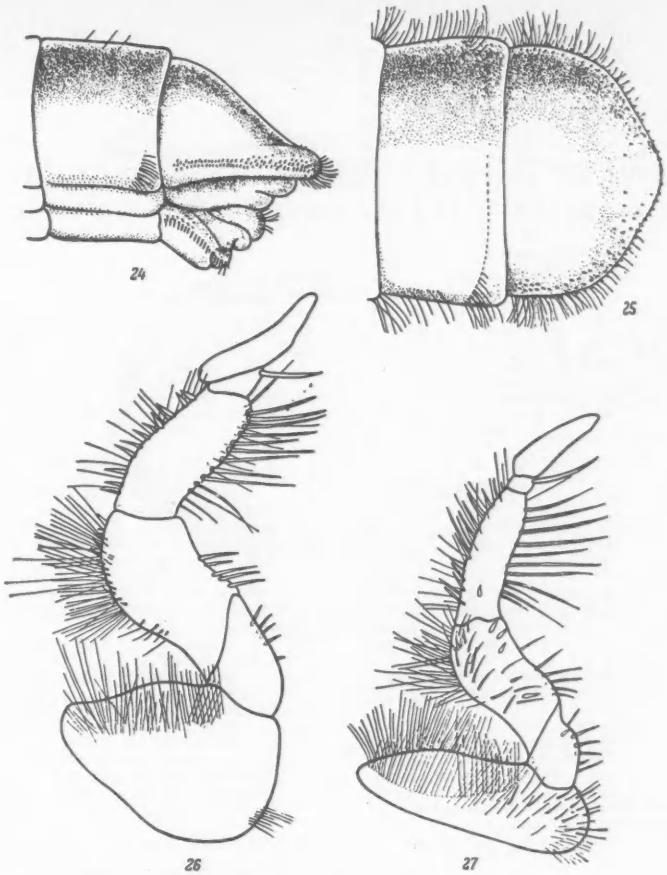
Legs. First pair (Fig. 26). Tarsus furnished with an elongated, strongly sclerotized claw. One thick, long seta basally on claw on the inner side of the tarsus. Tibia with a comb of ten to twelve setae on the inner and outer margins, those on the inner margins being longer and thicker. Femur bears four to five setae in a row on the inner margin. Outer margin set with spinelets, setae and hairs. Trochanter bears three to five stout spinelets and a few setae on the inner surface. Coxa forms a curved platform on the outside; the femur is inflexed and invaginated into this. This depression, transverse relative to the line of symmetry of the body, is marginally bordered with a broad band consisting of three or four rows of long slender hairs. The armature of the second and third pairs of legs is similar (Fig. 27). Tarsus bears a strongly sclerotized, narrow, long, flat claw with one thick seta at its base. Tibia bears a comb of nine to ten setae on inner margin and another of fifteen to sixteen setae on the outer margin. On the posterior surface there is a stout spinelet near the base. The femur has on its inner surface a platform bordered with spinelets on both sides; there are five spinelets on the boundary with posterior surface; distal half of outer femoral surface densely covered with long setae extending beyond the adjacent part of the posterior surface. Four or five spinelets in a row anteriorly on trochanter, one posteriorly. Coxa thickly covered with spinelets and hairs except for the outer surface, which is curved and without armature.

The imago of this species has been described by Bogachev from material collected in the Astrakhan province. We have found grubs and imagos at the settlement of Nov. Bogadinsk, Gur'yev province, in broken down barkhan sands. The grubs occur at a depth of 15-20 cm in wet sand among the roots of Salsola nitraria Pall. and Aristida pennata Trin. Ten grubs were examined.

Trigonoscelis muricata Pall.

Maximum length of grubs examined 32 mm. Larva very similar to that of the preceding species, from which it is distinguished by the following characters.

Head. Two irregular rows of short spinelets above, originating from the base of the antennae and converging towards the middle of the posterior margin of the head. Labrum (Figs. 28, 29) transverse, its width only two and a half times its length; setae in marginal bands longer; bands uneven and not dense; transverse band consisting mainly of flat setae with sparse hairs disseminated among them. Marginal row on epipharyngeal surface consisting of thirty to thirty-two chaetae. Excavation of anterior margin smaller, the setae filling it being longer and retrorse. Epipharynx bears six small spines medially. The two spines on posterior margin of epipharynx twice as thick and stout as those in Diesia argentata. Shape of tormae differs sharply from that found in Diesia argentata; tormae have one sharp stout retrorse spine and two blunt antrorse processes. Mandibles strongly sclerotized; larger and more prolate, length to width ratio 32:25; excision deep,



Figs. 24 - 27: Diesia argentata Bog., larva. 24 - 8th and 9th segments laterally; 25 - the same viewed from above; 26 - first pair of legs; 27 second pair of legs.

extremities more acuminate (Fig. 30). No substantial differences in the structure of the remaining mouthparts. Clypeus transverse, its width two and a half times its length.

Segments. Length to width ratio similar to that of Diesia argentata. Ninth abdominal segment obliquely truncate laterally, making an angle of 45° with the ventral surface. Transition to flattened apex of segment of a gradual, flattened surface occupying approximately half the segment (Figs. 31, 32).

Legs. Leg armature differs from that of Diesia argentata in the following characters. First pair. Tibia bears a comb of seventeen to eighteen setae on inner margin and fourteen to sixteen on outer margin. Second pair (Fig. 33) and third pair. A row of setae running along the outer margin of the tibia towards the base doubles and becomes two rows. Femur. Platform on inner surface demarcated from posterior surface by seven spinelets. Trochanter almost entirely covered with small spinelets except for four or five large spines.

We found two P. muricata Pall. grubs in semi-fixed hummocky sands in the Volga-Ural sandy terrain: one in the Tash area, Gur'yev province, the other at the Yeltay settlement, Gur'yev; both were among roots of Artemisia arenaria DC. and Salsola ruthenica Iljin.

Key for Identification of Larvae of the Tribes Pimeliini and Platyopini

1 (2) Tarsus of first pair of legs bears eight or more setae on inner margin (tribe Platyopini). Claw of first pair of legs bidentate (Fig. 19), anterior margin of eighth and ninth tergites furnished with spinelets (Figs. 15, 16).....Platyope leucogramma Pall.

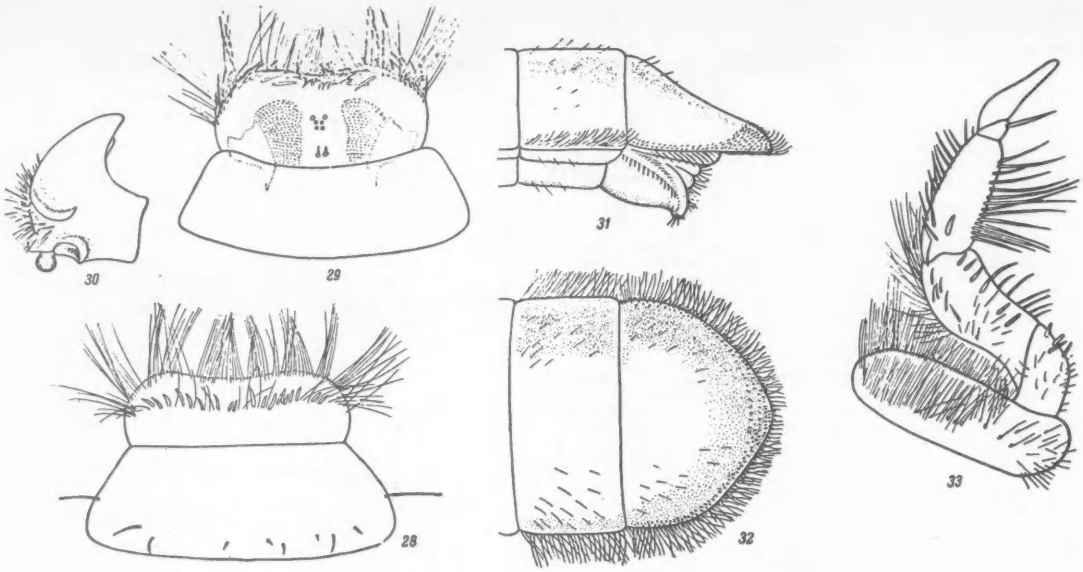
2 (1) Tarsus of 1st pair of legs bears not more than two setae (Fig. 8) (tribe Pimeliini).

3 (6) Tergites covered with more or less dense hairs. Anterior margin of ninth tergite bears spinelets (Figs. 1, 2, 3, 12, 13). Median row on exterior surface of labrum consists of uniform stout setae (Fig. 5).

4 (5) Very hirsute. Anterior margin of eighth tergite furnished with short spinelets (Figs. 1, 2, 3). Base of maxillary palpus articulated, as in most darkling beetles, to "trunk" and running parallel to longitudinal axis of maxilla (Fig. 7)..... Pimelia subglobosa Pall.

5 (4) Less hirsute. Anterior margin of eighth tergite bears no spinelets (Figs. 12, 13). Base of maxillary palpus articulated to masticatory lobe (lacinia + galea) and running from it perpendicularly to the longitudinal axis of the maxilla (Fig. 11)..... Pimelia capito Kryn.

6 (3) Tergites almost without hairs. Anterior margin of ninth tergite without spinelets (Figs. 24, 25, 31, 32).



Figs. 28 - 30: Trigonoscelis muricata Pall., larva. 28 - Labrum and clypeus from above; 29 - the same, from below; 30 - mandible. Figs. 30 - 33: Trigonoscelis muricata Pall., larva. 31 - 8th and 9th segments laterally; 32 - the same, from above; 33 - second pair of legs.

Median row on exterior surface of labrum consists of long slender hairs, among which are flat setae (Figs. 21, 28).

7 (8) Tormae have each two sharp antrorse spines, one retrorse spine and one introrse spine (the latter meeting each other) (Fig. 22)..... Diesia argentata Bog.

8 (7) Tormae have each two blunt antrorse spines and one large, sharp, retrorse spine (Fig. 29)..... ..... Trigonoscelis muricata Pall.

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Zoological Museum, University of Moscow

DESCRIPTION OF THE LARVAE OF THREE SPECIES OF THE SUPERFAMILY OF LEAF-HORNED BEETLES (COLEOPTERA, LAMELLICORNIA) FROM TADZHIKISTAN

S. I. MEDVEDEV

Dorcus severtzovi Sem.

The larva is very similar to that of D. parallelopipedus L., from which it differs only as regards some very minor characters. The head (Fig. 1) is widest a little beyond the middle, shiny, covered with fine reticular rugae and yellow-brown; the frontal angles cephalad of the clypeus are black-brown, the clypeus brown with a broad, light yellowish-brown fringe anteriorly, the labrum brown, somewhat lighter than the clypeus, the mandibles black throughout. The height of the frontal triangle is twice the length of the epicranial suture, its apex being broadly rounded. Beyond this apical rounding the frontal sutures at first run almost directly forward, then become arcuately concave and anteriorly somewhat undulate and arcuately convex. There is a longitudinal row of setae running caudad and slightly inwards from near the middle of the frontal suture, on each side of the vertex; exteriorly to these rows there is one seta on each side at the apical level of the frontal triangle and one on each side opposite the anterior part of the frontal suture; there are up to 3 setae in front of the base of the antenna. On the frons there are three setae on each side anteriorly, near the sutures, and six on the anterior margin. The anterior margin of the frons and the base of the clypeus are medially depressed. The clypeus is trapezoidal and smooth, with two central setae. The labrum is transversely oval, smooth, with two central setae, fairly numerous, irregularly scattered setae in the basal half and the usual marginal markings. The mandibles are as in D. parallelopipedus but without striation. First antennal segment (Fig. 2) one third the length of the second, which is the longest; third (Fig. 3) four fifths the length of the second, covered with fairly numerous margined pores, each bearing a very small seta, fourth segment a quarter the length of the second and two sevenths the length of the third, small, bearing one seta above and two below and two very small hairs apically.

First spiracle slightly smaller than second (largest), 3rd just smaller than 2nd, 4th just smaller than 3rd, 5th appreciably smaller than 4th, 6th much smaller than 5th, 7th (smallest) slightly smaller than 6th, 8th and 9th almost the same size and barely larger than 6th (similar to 7th). Anal tergite covered with small setae set sparsely in one transverse row. Anal plate (Fig. 4) cordate, with two oval apical discs situated on either side of the anal cleft, as in D. parallelopipedus, but wider, slightly transverse (the setting of the anal cleft walls being uniform), apical discs relatively somewhat larger. Anal sternite (Fig. 5), except anteriorly, covered with tiny spinelike setae, with two areas of erect spinelike setae medially, extending on each side towards the median axis of the body, backward and inwardly; these setae become gradually denser towards the center and the outermost on each side of the areas form an arcuate row containing up to 40 of them; the rows diverge caudad from a point slightly before the middle of the sternite, in the form of an arc, forming the boundary of a central bare space, triangular in shape, with somewhat concave lateral margins. Legs as in D. parallelopipedus. On the outer side of the mid coxae there is a stridulatory keel similar to that of the latter species (Fig. 6, 7) consisting of some 40 circular granules arranged in one row, except that in places there are individual granules outside the row. Claws (Fig. 8) similar on all legs: straight, with curved apex, sharp, with two fine setae near the apex. Remaining characters as in D. parallelopipedus. Body length of 3rd-instar larva 51 mm; length of head 3.8 mm, width of head 5.0 mm.

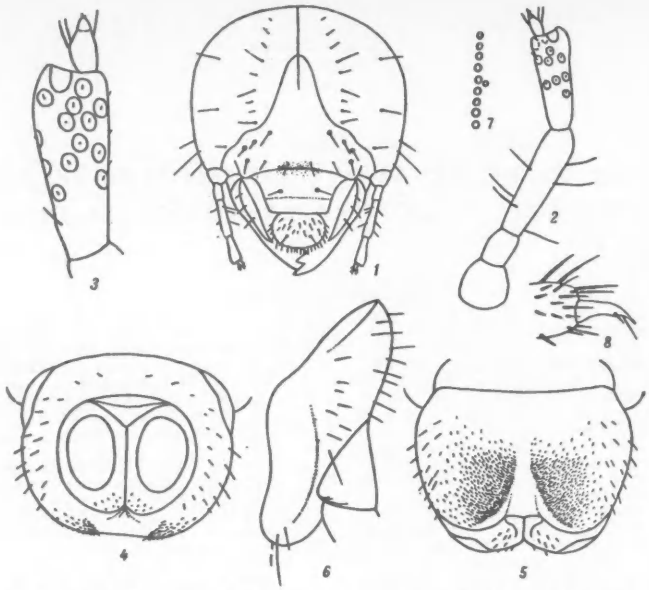
The larva of the species described differs from that of D. parallelopipedus in that its maximum size is slightly smaller (58 mm in D. parallelopipedus), the head capsule is smaller (5.2-5.5 mm wide in D. parallelopipedus), and different in shape (the median width being greatest in D. parallelopipedus), the color of the mandibles is different (basally brown, apically black in D. parallelopipedus), the relative sizes of the spiracles are different (in D. parallelopipedus the 5th is just smaller than the 4th and the 8th just smaller than the 9th), the anal plate is wider and the apical discs relatively larger, the granules of the stridulatory apparatus are set less closely together in the row and there are fewer of them (up to 50 in the row in D. parallelopipedus) and there are separate granules standing outside the row (instead of regular rows as in D. parallelopipedus).

Three specimens of 3rd-instar D. severtzovi larvae were collected by I. K. Lopatin along with adult beetles in Tadzhikistan, on the southern slopes of the Vakhsh range in the Sarkoron district at an absolute altitude of 1640 m in an old Oriental plane wood (Platanus orientalis L.) on 23 June 1958.

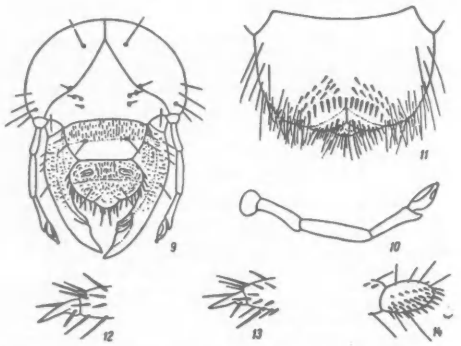
Trochaloscheme medusa Reitt.

Body fairly well-proportioned, curved C-shaped. Head (Fig. 9) widest medially, without ocelli near base of antennae, finely reticularly regulose, shiny, brownish-yellow, frontal angles cephalad of frons and apices of mandibles black. Height of frontal triangle three times as great as length of epicranial suture, its apex forming an acute angle (about 60°). Frontal sutures almost straight posteriorly, arcuately convex anteriorly. One seta on each side of the vertex at the level of the apex of the frontal triangle, one on each side in front of the median frontal suture and several (up to 4) in front of the antennal base. Three setae on either side of the anterior, dilated part of the frons and one on each side of its anterior margin, situated inwardly from base of antenna. Clypeus trapezoidal, with fine longitudinal rugae basally and a broad, smooth, light yellow border anteriorly; two medial and four lateral (two each side) setae. Labrum transversely oval, rather delicately rugulose, with a rugose transverse carina medially, two medial setae and the usual marginal markings. Mandibles basally transversely rugose with numerous setae exteriorly. Antennae (Fig. 10) slender, long; the second segment the longest and appreciably longer than the third, which is barely longer than the first; the fourth shorter than the first, with a large oval plate above and a small oval plate below on the apical part; three very small hairs at apex. Spiracles small, light-colored, the first larger than the rest, which are all approximately the same size.

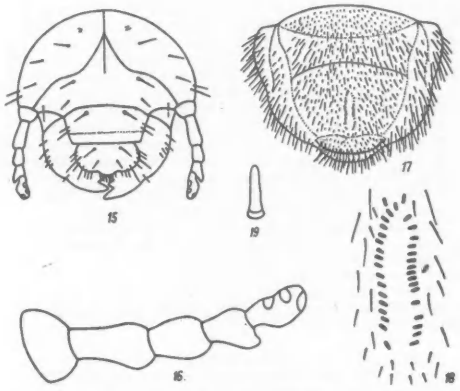
Anal tergite posteriorly covered with fairly dense, short, brown, spinelike setae and fairly numerous long, yellow hairs. Anal plates bearing long brown spines and hairs. There is a moderately



Figs. 1 - 8 - Structural details of Dorcus severtzovi Sem. larvae. 1 - head; 2 - antenna; 3 - antennal extremity; 4 - anal tergite; 5 - anal sternite; 6 - mid coxa; 7 - part of stridulatory carina; 8 - claw.



Figs 9 - 14 - Structural details of Trochaloscheme medusa Reitt. larvae. 9 - head; 10 - antenna; 11 - dorsal part of anal sternite; 12 - foreleg claw; 13 - median leg claw; 14 - extremity of hind leg.



Figs. 15 - 19. - Structural details of Potosia bogdanovi Solsky larvae. 15 - head; 16 - antenna; 17 - anal sternite; 18 - symmetrical rows of spinelets; 19 - individual spinelet from symmetrical rows.

arcuate, convex, transverse row (as in other Sericini) of 14 straight, thick, retrorse spines on the posterior part of the anal sternite (Fig. 11), cephalad of the apex of the anal longitudinal slit; cephalad of this row is an area containing a small number (26 or just under) of straight, spinelike setae arranged mainly in two (only in individual cases are there more) transverse rows and situated outward of and backward of the median axis of the body; the anterior margin of this area falls well short of the mid-dorsal part of the anal sternite and is cut completely into two by a bare space in the middle. The fore and mid legs (Figs. 12 and 13 respectively) terminate in straight, apically spiculate claws, each bearing two fairly slender setae; the hind legs lack claws (Fig. 14). In other respects the species resembles Amaladera euphorbia Burm. Body 19-25 mm long; head 1.3 mm long and 2.1 mm wide.

All known Sericini larvae are very similar to one another, differing mainly as regards small characters. The larva described above is distinguished from those of Serica and Maladera primarily by the absence of ocelli, and from Homaloplia by the less convex, arcuate, transverse row of spines on the anal sternite, the size and shape of the area occupied by spinelike setae (in Homaloplia this reaches the mid-dorsal part of the anal sternite or extends beyond it, is medially divided by an indistinct bare space or is continuous, lacking such a space), and by the structure of the clypeus (which lacks longitudinal rugae in Homaloplia). It differs from Amaladera euphorbiae Burm. in the length ratios of the antennal segments (in the latter species the first segment is half the length of the 2nd, whereas in the species described it is only one third shorter), the number of spines in the transverse arc on the anal sternite (in A. euphorbiae there are 18-20 of these), the much smaller number of spine-like setae on this sternite (50 or just under in A. euphorbiae) and the shape of the claws (these are curved and lack setae in A. euphorbiae). Differences from

Leucoserica arenicola Solsky are the much longer antennae and the different length ratios of the antennal segment, the structure and chaetotaxy of the clypeus and labrum, the number of spines in the transverse arc on the anal sternite (18 or just under in L. arenicola) and other characters.

Two third-instar larvae were collected in Tadzhikistan, one at Kondara on 26 April 1957 at an absolute altitude of 1700 m and one from the soil of a grassy plot near peach trees on 15 May 1957. These sites lie within the Trochaloscheme medusa Rtt. area and conditions are the same as in the habitats of that species. Representatives of other Sericini genera were not found here; the larvae in question must therefore be tentatively identified as Trochaloschema medusa.

Potosia bogdanovi Solsky

Body thick, C-shaped as in the case of Cetonia aurata L. larvae and other species of Potosia, covered with fairly numerous, moderately long hairs. Head (Fig. 15) widest in front at base of antennae, finely reticularly wrinkled; shiny, yellowish-red-brown, anterior part of frons and basal half of clypeus darker, brown; anterior part of clypeus light yellow; labrum basally brown, anteriorly yellow; each antennal segment lighter apically; mandibles brown, apically black. Height of frontal triangle more than twice as long as epicranial suture, its apex forming a very acute angle. Frontal sutures apically almost straight, then slightly arcuately concave but arcuately convex in the anterior half. One seta each side on vertex at level of apex of frontal triangle, one each side outwardly, and almost cephalad of this one opposite the anterior quarter of the frontal sutures, and two behind base of the antenna; in addition, there are single, very small hairs in the dorsal part of the vertex. Two setae on frons, one on each side, near the middle of the frontal suture, one on each side in front of this and slightly inward of the line of the external clypeal angles, one on each side inward from bases of antennae near the anterior frontal margin. Clypeus smooth, trapezoidal, with two medial setae set near the basal margin and two on each lateral margin. Labrum, as in other Cetoniinae, trilobed anteriorly, with two pairs of setae arranged in transverse rows, the first pair being nearer the base and the second in the apical half, and with the usual marginal setae and a cilia. Mandibles with numerous setae externally. Antennae (Fig. 16) relatively short and thick; first segment half as long again as 2nd, slightly oblong in shape; terminal segment just shorter than 3rd, also slightly oblong, but with a well developed dentiform process externally on the distal extremity; 4th segment just longer than 2nd, with two small identical plates above and one, larger, below at apex.

First thoracic segment with a large yellow-brown sclerite laterally, first spiracle slightly larger than the rest, which are all the same size. Anal sternite (Fig. 17) densely covered with small, erect, spinelike setae and long hairs, the latter predominating cephalad of the median fold and laterally, and without distinct bare spaces. There are two symmetrical rows (Fig. 18) each containing 16-18 relatively long (4 times their width) spinelets, which are broadly rounded and only slightly narrowed apically; the anterior ends of the rows reaching the beginning of the last third of the anal sternite, where they converge; from here they diverge caudad to the extent of the first two or three spinelets, then run parallel and are widely separated at their posterior ends where they barely converge again. These rows are not quite regular; individual spinelets stand outside them at the anterior ends of the rows and laterally; the distance between the rows is less than a third of their length. Legs as in other species of Potosia. Body length of 3rd-instar larvae 68 mm; head 3.0 mm long and 5.9 mm wide.

The species described differs from the other known Potosia larvae in the very acute apex of the frontal triangle. The absence of bare parts on the last sternite, the presence of small hairs on the vertex and of setae on the anterior part of the frons indicate that the species belongs to the subgenus Netocia. The presence of more or less numerous small, spinelike setae on the anal sternite make the larva similar to that of Potosia karelini Zoubk. but in the latter the hair cover of the terminal sternite is thicker and longer, with long hairs more predominant; the arrangement of the setae on the head is different; so too are the shape of the symmetrical rows of spinelets on the anal sternite and the shape of the spinelets themselves, which have much wider, broadly rounded apices. The size of the body and the head capsule of the larva show that the apices belongs to the largest of the Potosia species (Netocia). Of these only Potosia bogdanovi Solsky occurs here; it is known from Varzob and other contiguous points, being found up to absolute altitudes of 2000 m in the mountains. This gives grounds for believing the larvae described belong to this species.

Two larvae were found in the Varzob district of the Tadzhik SSR in February 1958, in walnut roots (Juglans regia L.) and at Ramshit under similar conditions on 28 August 1958 (P. N. Kulinich).

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A NEW SPECIES OF PSYLLIODES (COLEOPTERA, CHRYSOMELIDAE) FROM THE USSR

V. F. PALIY

In 1950 A. Ye. Moiseyev described a major wheat-grass (Agropyron) pest from the arid part of the Povolzh'ye. This was a flea beetle, which he named Psylliodes cucullata Ill. In a later paper (1956) he again mentions it as a pest, describes its appearance and indicates its occurrence in the left bank districts of the Saratov province, where it is present in huge numbers (from 10,000 to 45,000 specimens per 100 sweeps of the net, or some 1500-2000 per m^2).

Ps. cucullata is a palaearctic northern species, fairly abundant in the taiga and forest-steppe parts of Western Siberia, particularly in Cis-Uralia, somewhat less common in the corresponding regions of Eastern Siberia. It is rare in Soviet Europe, where only three specimens of it have been collected from forest steppelands in eleven years. It has not been found at all under steppe conditions in Europe or Asia.

The habitats of this species are thus mainly in places where there are moderately warm and wet mixed and coniferous forest conditions. It is obviously rather moisture-loving and thermophilic. Its appearance in large numbers under the warm, arid conditions of the Povolzh'ye left-bank steppes is highly improbable. A. Ye. Moiseyev has kindly sent us a considerable number of specimens of the flea beetle, which he collected from wheat-grass in the Krasnyy Kut district. This is the species earlier identified as Ps. cucullata Ill.

Comparison of this material with Ps. cucullata collected from Cis-Baykal, the Altay region, Cis-Uralia, the Urals and the forest steppe in the Central-Chernozem belt showed that the Povolzh'ye species is a different one. It can be distinguished from Ps. cucullata by some fairly clearcut morphological characters and by its size, and obviously has quite different ecological characteristics from those of cucullata.

After examining the material at the Institute of Zoology of the USSR Academy of Sciences one is justified in concluding that this insect belongs to a new species. In view of its close ecological and trophic association with wheat-grass we have named it Psylliodes agropyri, sp. n. Types, from Krasnyy Kut, Saratov prov., are in the Leningrad collection of the Institute of Zoology.

Psylliodes agropyri, sp. n.

Antennae and legs red and yellow except for hind femora, which are blackish. Abdomen and thorax black, greenish bronze above with metallic sheen. Head relatively large, vertical, not visible from above. Frons flattened, punctate. Pronotum transverse, strongly convex, somewhat constricted apically, where it bluntly and roundly truncated and has dense, coarse puncturation; spaces between punctures barely larger than diameter of punctures. Lateral angles apically truncated but noticeably protuberant. Scutellum transverse, apically rounded, small. Elytra with very slight humeral tubercles or almost without these, thickly and very coarsely punctate. Punctures in rows, in places double. Areas between rows narrow, not more than 2 to 2.5 times the diameter of the punctures in the rows. Elytra prolate, with parallel sides, apically rounded, straight along lateral margins, not emarginate above hind femora. Body more or less terete, very slightly convex above, the median part of the elytra even slightly flattened. Length 1.7-2.2 mm, width of pronotum 0.5-0.8 mm, greatest width behind shoulders 0.6-1.0 mm.

Morphologically the species resembles Ps. roddi Jacobs. and Ps. macella Wse., as well as Ps. cucullata Ill.; ecologically, however, it is nearer to Ps. reitteri Wse. It belongs to the subgenus Semicnema.

The following key permits comparison between Ps. cucullata and other similar species with Ps. agropyri.

1 (4). Head perpendicular, fronts flat, pronotum thrust up against head, which is invisible from above. Color of body bronze-alutaceous with a metallic tinge.

2 (3). Body broadly oval, smoothly rounded towards the fore and hind extremities, its greatest width being in the first third of the elytra. Base of elytra appreciably wider than base of pronotum, which is triangular, smoothly rounded apically (ween from above), with abruptly protruding downward angles. Pronotal punctures dense, moderately deep, the spaces between them being equal to, or slightly greater than, the diameter of the punctures. Elytra conspicuously emarginate laterally from a point opposite attachment of the hind femora to the apex, with rows of regular punctate furrows formed of moderately small punctures, the spaces between the rows being 4-5 times wider than the rows themselves. Length 2.5-2.6 mm, width of pronotal base 0.9-1.0 mm, maximum width of elytra 1.3-1.5 mm..... ..... Psylliodes cucullata Ill.

3 (2). Body elongate, parallel-sided, more or less terete, widest at the shoulders. Base of pronotum not narrower than base of elytra; pronotum slightly constricted apically, where it is bluntly rounded, trapezoidal (seen from above), the lateral margins projecting tooth-like apically. Pronotal punctures thick, rugulose, deep, the intervals between them negligibly larger than their diameter. Elytra straight along lateral margins, with rows of coarse, wide, punctate furrows, in which the punctures are in places doubled or displaced; spaces between rows narrow, not more than 2 to 2.5 times the width of the rows. Length 1.7-2.2 mm, base of pronotum 0.5-0.8 mm, maximum width 0.6-1.0 mm..... ..... Psylliodes agropyri, sp. n.

4 (1). Head set obliquely downward and forward, frons convex; pronotum does not shield head, which is readily visible from above. Color black, with a slight metallic sheen.

5 (6). Prenotal punctures deep, distinct, sparse, spaces between them smooth. Slightly but evenly convex above. Frons evenly punctate, the punctures minute..... ..... Psylliodes roddi Jacobs.

6 (5). Pronotal punctures small, very sparse. Slightly convex, dorsum slightly flattened. Frons conspicuously and evenly punctate. Labrum broad, smoothly curved ..... Psylliodes macella Wse.

The distribution of the species described has not been determined. Its area may consist of the plain between the Volga and the Urals, and the western part of Kazakhstan. The species most resembling it morphologically — Ps. roddi and Ps. macella — infest the Altay mountains.

The ecological distinctness of this species from Ps. cucullata allows the hypothesis that this is not an ecological-geographical race, but a particularly isolated species.

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A NEW PEST OF THE SPRUCE PICEA SCHRENKIANA FROM SOUTH KIRGIZIA (COLEOPTERA, CURCULIONIDAE)

M. YE. TER-MINASYAN

A new species of weevil of the genus Magdalis, which I discovered in I. K. Makhnovskiy's collections from southern Kirgizia, is described below. The types are in the Leningrad collection of the Institute of Zoology, USSR Academy of Sciences.

Magdalis (Magdalinus) aeneus Ter-Minasian, sp.n.

Black with bronzy sheen, completely and evenly covered with fairly dense, yellowish, closely placed hairs. Beak of equal length with pronotum in male or with head and pronotum together in female, curved, distinctly thicker in male than in female, rather densely punctate, slightly shiny; in female, beak more sparsely punctate above and distinctly shiny. Eyes large, rotund, not convex, not protruding from head. Antennae in male attached near the middle of the beak, in female beyond the middle. Antennal scape distinctly curved; 1st flagellar segment longer than half the first, the rest differing little in length, transverse; club large, with well demarcated segments. Pronotum almost as long as its basal width, above and laterally rather strongly roundly convex, strongly constricted beyond the anterior margin, its dorsal angles drawn out and spiculate; entirely covered with very dense, fine granulation, which is particularly dense laterally on the anterior half and when viewed from below or from the side looks like a carina along the lateral pronotal margin. Scutellum small and semicircular. Elytra not less than twice as long as the overall shoulder width, with base straight and curving towards the scutellum; each elytron depressed beyond the base, so that the anterior margin is distinctly elevated. Elytra slightly dilated caudad from the shoulders, with regular rows of small punctures; intervals between these rows wide, flat and covered with two, or in places three irregular rows of fairly large p punctures, differing little in size from those form-in the rows, so that at first sight the entire elytron surface seems to be covered with a tangle of punctures. The elytra leave only the apex of the pygidium exposed. All femora, each with a small tooth, the ones on the fore femora slightly larger than the others. Length 5.4 mm.

Arkit, south Kirgizia, under the bark of Picea schrenkiana branches, 20 May 1956, 2 ♀♀ (including allotype); 27 October 1958, 2 ♂♂ (including holotype), Makhovskiy.

The species is well distinguished from all other species of the subgenus Magdalinus Germ. by its metallic, bronzy hue, the even, fairly thick cover of yellow hairs and the sculpturing of the surfaces of the elytra.

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NOTES ON THE CARPENTER BEE FAUNA (HYMENOPTERA, APOIDEA, XYLOCOPINI) OF THE USSR

V. V. POPOV and A. A. PONOMAREVA

It is evident that the Xylocopini coincide with tropical and subtropical forests and are native to those regions. Their ecological association with tree and shrub vegetation as pollinators of the latter and as species breeding in dry or dying wood is also undisputed.

Some 300 species of Xylocopa and related genera are known from tropical and subtropical regions, but this fauna has so far been very incompletely studied and only in relation to isolated areas; the actual number of species is undoubtedly a good deal higher. More than 40 are known within the Palaearctic region, and as research has shown, 20 of them occur in the fauna of the USSR as well.

That these species are native to the Palaearctic region is not in dispute; nor is their Tertiary origin in dispute. Three species are known to have existed in upper Miocene times; one has been found in Middle Oligocene deposits in Western Germany.

The Xylocopini fauna of the USSR has been very little studied. In an earlier paper, one of the present authors (Popov, 1947) considered species of the genus Proxylocopa and several species of the subgenus Xylocopa (s. str.), including the two commonest palaearctic species, X. violacea L. and X. valga Gerst.

In the present note we give a redescription of one subgenus and information on new or little-known species from the USSR fauna, based on supplementary material held by the Institute of Zoology (USSR Academy of Sciences), the Moscow University Zoological Museum and other institutions.

Subgenus COPOXYLA Maa

Maa, 1954, Meddel. f. Dansk. Naturh. For. i Kobenhavn, 116:211.

Body medium-sized or small, 16-24 mm, black, with metallic hue; ♂ with light yellow or black clypeus; lateral parts of face sometimes partly or wholly light yellow. Pubescence lback; hairs on anterior margin of mesonotum and first abdominal tergite in male usually light; there is sometimes an admixture of light hairs on face, and the tarsi of both sexes are partly covered with light hairs. Inner orbits almost parallel in male. Frontal carina low and weak. Ocelli arranged in a triangle with base twice as long as height. Labrum of female with a conspicuous tubercle medially near base, labrum of male with three high longitudinal keels. Mandibles bidentate in male and tridentate in female. Mesonotum usually with small non-punctate area. Hind tibia with two short denticles in second third; in the male, sometimes only one denticle is developed. Inner tooth of claws in male almost parallel to claw. 6th tergite with low, even, very narrow pygidial area, appreciably dilated and flat at base, heavily depressed in terminal half. 8th sternite of male with long, narrow lateral plates; median part narrow, trapezoidal, with almost straight anterior margin. Gonobase with a pronounced angular extension laterally at base of gonocoxite. Gonocoxite of male copulatory organ short, broad, angularly or circularly prolate medially to a sharply defined apex.

Type species: Xylocopa iris Christ, 1791.

The subgenus also includes: X. turanica F. Morawitz, 1875; X. uclesiensis Perez, 1901 with var. gracilis Dusmet, 1923; X. sogdiana Popov et Ponom., sp.n. and, possibly, X. rogenhoferi Friese, 1900.

This subgenus is closely related to the subgenus Xylocopa (s. str.) but differs as regards the structure of the pygidial area on the 6th tergite of the female, which in Xylocopa (s. str.) species always has a dentiform extrusion medially, cephalad of the depressed part, while the males have short gonocoxites with a short well defined apex, unlike Xylocopa (s. str.) species, in which this apex is either not separated by a preapical constriction or, conversely, the constriction is very long. A further difference is that the gonobase is prolate at its base instead of being short throughout, as in Xylocopa (s. str.).

Biologically, the subgenus in question differs sharply from Xylocopa (s. str.). As Maeterlinck (1911), Fahringer (1922), Malyshev (1947) and Serkova (1953) have shown, species of this subgenus doe not breed in trees but build their nests in umbellifer stems (Peucedanum alsaticum L., Heracleum spondylium L. and others) or in those of Compositae (Lappa, Artemisia arborescens L., Carduus, Helianthus annuus L.), Gramineae (Zea), Lonicera (Sambucus ebulus L.) and Liliaceae (Asphodelus). Malyshev made a detailed investigation of the evolutionary aspect of the transition from the ancestors of Copoxyla Maa species to breeding in plant stems and has shown the complex modifications of instincts associated with this transition.

Key for Identification of the Species of the Subgenus Copoxyla Maa

♀♀

1 (2). Teeth on outer side of hind tibiae always blunt, almost square and of almost equal size, their surface shiny. Clypeus for the most part coarsely rugulose punctate. —Transcaucasia, Kopet-Dag, Central Asian mountains and foothills, Central Kazakh steppes; Iran. ..... X. turanica F. Mor.

2 (1). Teeth on outer side of hind tibia equal in size, the lower one always longer than the upper and acutely spiculate, its surface almost mat. Clypeus always finely rugulose punctate.

3 (4). Lower tooth of hind tibia long and sharp, upper one shorter and blunt. Body pubescence black. —Mediterranean, South Ukraine, including Crimea, Transcaucasia, Kopet-Dag, southeastern part of Soviet Europe. . ..... X. iris Christ

4 (3). Both teeth of hind tibia spiculate, the anterior one being twice as long as wide. Admixture of rusty-reddish hairs on face, anterior margin of mesonotum, first abdominal tergite and sides of 2nd-4th tergites and sternites. —Spain. ..... X. uclesiensis Perez.

♂♂

1 (6). One tooth on outer side of hind tibia. Wings mostly with distinct metallic sheen.

2 (3). Clypeus completely and lateral parts of face partly or completely light ..... X. turanica F. Mor.

3 (2). Clypeus and lateral parts of face black.

4 (5). Abdomen with metallic blue reflections. Body hairs black except for light bands on anterior margin of mesonotum and first abdominal tergite..... X. iris Christ.

5 (4). Abdomen black with slight bronze-ish reflections; head and thorax with rusty-reddish pubescence..... .....X. uclesiensis Perez.

6 (1). Two small teeth separate from each other on outer side of hind tibia. Wings light alutaceous with a darker external margin and a very slight violet hue along the extreme outer margin — Central Asian Mountains (Zeravshan, Peter I range).....X. sogdiana Popov et Ponom.

Xylocopa (Copoxyla) iris Christ.

This species is widely distributed in the Mediterranean region. In the USSR it has been noted, mostly under the name X. cyanescens Brulle, without precise locations, in Moldavia (Malyshev, 1947), Crimea (Aggeyenko, 1890; Malyshev, 1931 and 1947), the Kizlyar district (Malyshev, 1947), Transcaucasia — Nikolayevka and Adzhikent (Moravits, 1878), Murut, Kirovobad, Derbent (Maidl, 1911), Abkhaziya and Talysh (Malyshev, 1947), Yanvartsev in Western Kazakhstan (Popov, 1952) and Mugodzhar (Malyshev, 1947). The indication that it occurs in the Gissar range and "Tschintschantan" (Maidl, 1911) should probably refer to X. (X.) turanica F. Mor. In Central Asia it is known only from Chula in the Kopet-Dag and from Tedzhen (Morawitz, 1895; Malyshev, 1947).

The northern boundary of the species in the USSR extends from Baurchi, Moldavia (A. Chernavin), the Bay of Kinburnsk in the Denprovo estuary (S. Medvedev) and the Crimea to the Khoperskiy reservation in Balashovo province (Malyshev, 1947), the Syzransk district (Bostansholgo) the Guberlinsk mountains (F. Morawitz coll.), Orenburg (P. Vorontsovskiy), Spassk in the Orenburg province (E. Eversman coll.) and Ber-Chugur near Mugodzhar (N. Androsov). Farther east the species is so far unknown. Distribution is sporadic, particularly in the northern part of the area. It is interesting that the species has not been found in the provinces of L'vov (Noskiewicz, 1922), Stanislavsk (Kuntze and Noskiewicz, 1938), Kiev (Lebedev, 1933), Belogorodsk (Malyshev, 1947), Khar'kov (Yaroshevskiy, 1881) or Denpropetrovsk (Bramson, 1879), or in the steppes of the Right-bank region of the Ukraine (Osichnyuk, 1959).

It is fairly abundant in south Crimea, where it has been found in the following localities: Simferopol' (N. Kokuyev), Sevastopol' (V. Pliginskiy), Bel'bek (N. Kuznetsov), Sudak (D. Glazunov), Krestovaya nr. Alupka (N. Kuzentsov), Ayu-Dag (N. Kuznetsov), Nuru-Uzen' nr. Alushty (Simferopol' Museum coll.), Otuza (Yu. Kostylev), Khersones (V. Pliginskiy), Kerch' (A. Kirichenko). In the northern (steppe) area it has not been found. It is also known from Anapa (V. Malyshev), Ashsha nr. Tuapse (V. Brodin), Stavropol' (I. Ioffe) and the Aleksander-Nevskiy Station nr. Kizlyar (N. Olsuf'yev). It is known in Transcaucasia, in addition to the places mentioned above, from Gagr (F. Luk'yanovich), Tash-Bulak nr. Nukhi (O. Bocharnikov), Kirovabad (Vinovskiy), Lagodekh nr. Zakatal (L. Mlokosevich), Yerevan (V. Vuchetich), and from the Kaz-Yurda, Zuvant and Talysh Mountains (D. Znoyko).

The biology of the species was studied by S. I. Malyshev (1947).

Earliest emergence is at the end of April (south coast of Crimea). Nest-building starts in early June in the Belgorod province (Malyshev, 1947). Males have been noticed in July and August as well. In Mediterranean countries the species emerges earlier (from March onwards in Yugoslavia and from the first few days of April in Morocco and Algeria; males have been found even in November (Saunders, 1908; Schulthess, 1924). Nevertheless, it can be assumed that the species has only one generation each year.

X. iris Christ seems to be a polytrophic species. According to the literature available to us, it has been found on 29 species of 12 plant families. Most of these are species with deep, highly specialized flowers of the families Iridaceae, Salicaceae, Caryophyllaceae, Rosaceae, Oleaceae, Umbelliferae, Leguminosae, Verbenaceae, Boraginaceae, Scrophulariaceae, Labiatae and Compositae. It is most commonly found, however, on pulses (7 species) and labiates (6 species).

Xylocopa (Copoxyla) turanica F. Mor.

Xylocopa turanica F. Morawitz, Izv. Obshch. lyubit. Yestestvoznan., antropolog., etnograf., 19 (2), 1875: 69, ♀ (nec ♂); Popov, Tr. Zoolog. inst. Akad. Nauk SSSR, 8, 1949: 693, ♀; Popov, coll. "Ushchel'ye Kondara", 1951: 171, ♀; Serkova, Tr. Resp. stants. zashch. rast. Kazakhsk. fil. VASKhNIL, III, 1956: 35; Serkova, Entom. obozr., 33, 1953: 186 (biol.); - X. signata F. Morawitz, Izv. Obshch. lyubit. yestestvoznan., antropolog., etnograf., 19(2), 1875: 69, ♂; Hedicke, Deutsch. Entom. Zeitschr., 1938: 190, ♀♂; Popov, coll. "Ushchel'ye Kondara", 1951: 171, ♂; var. subjugata Cockerell, Ann. Mag. Nat. Hist. (10), 5, 1930: 409 ♂ (nec ♀). X. cyanescens Maidl, Ann. K. K. Naturhist. Hofmus., Wien 26, 1912: 257 (syn. nov.).

This species was originally described from several females from the Zeravshan Range (Oburden, Varzaminor, Iskander-Kul') and one male from Sangi-Dzhuman. A second species, X. signata F. Mor., was described from males from the Zeravshan valley. As later material has shown, this second species is the other sex of the first, whereas the male of the first is another species (X. sogdiana, sp. n.), described below. The female of X. signata F. Mor. described by Hedicke from the Hindukush is the typical X. turanica female, as is obvious from an examina- of sufficient Central Asian material and comparison with the types not available to Hedicke.

The species has also been reported from Ak-Tash in the Chimgan range (Cockerell, 1930), Gissar (Popov, 1949), Varzob, Kondara and Kvak (Popov, 1951), the foothills of the Transilian Ala-Tau nr. Alma-Ata, the Bol'shaya Almatinka valley, and Turgen' (Serkova, 1953, 1956), as well as from the Western Pamirs and Kopet-Dag (Popov, 1951) and the Kirgiz range (Serkova, 1953).

It is widely distributed in Central Asia but its habitats are in foothills and mountains, where it is known up to an altitude of 3000 m (Fergana range).

New material: Kazakhstan — Koksengir, Karagandinsk prov., (Ye. Demyanov and A. Ponomarev); Kyr-Kol (I. Korzhenevskaya); Boguchal-Say (I. Korzhenevskaya); Dzhambul (K. Aris); Alma-Ata (S. Arkhangel'skaya); Maloye Almatinsk gorge (Zheludkova). Kirgiziya — Frunze (S. Kharin), Chor-Tash, Fergana range (V. Popov); Arslanbob, Fergana range (N. Kashkarov); Talassk Ala-Tau (collector unknown). Uzbekistan — Aman-Kutan (V. Gussakovskiy); Zevar, Gissar range (Ye. Kuznetsova); r. Chimganka, 75 km from Tashkent (O. Martynova); Yangi-Bazar (N. Skopin); Kara-Archa gorge, Turkestan range (P. Veltyshev); Pasha-Ata, nr. Namangan (N. Dzens-Litovskaya); the town of Fergana (K. Maurer). Tadzhikistan - Shing River, Zeravshan range (D. Glazunov); Takfon, Yagnob (D. Glazunov); Kshtut (D. Glazunov); Stalinabad (V. Popov); Karategin (coll. F. Morawitz); Kondara, Gissar range (V. Gussakovskiy); Kvak (V. Gussakovskiy, V. Rudol'f); Khodzha-Obi-Garm (V. Popov); Kabadian (A. Gol'bek); Gursy River - Tash, Kara-Shura valley, Peter I range (A. Gol'bek); Darvaz (coll. F. Morawitz); Vanch, w. Pamirs (A. Shtakel'berg); Togus River - Bulak, E. Shugnan (Makar'in); Derushon (Ye. Luppova). Turkmenia - Firyuza (K. Anger); altogether 42 ♀, 19 ♂. Azerbaydzhan — Nakhichevan' (A. Zagulyayev), 1 ♂. Iran — Demavend (D. Glazunov); Tash (coll. F. Morawitz); 1 ♀, 1 ♂.

The X. turanica F. Mor. area is thus very extensive, from Transcaucasia (Nakhichevan'), through the adjacent part of Iran (Demavend) and the Kopet-Dag (Firyuza), along the Central Asian Mountains to the steppes of Central Kazakhstan (Koksengir, Karagandinsk prov.) and south to the Hindukush. In eastern Transcaucasia and Central Kazakhstan it is probably contiguous to that of X. iris Christ, and in the Kopet-Dag it is certainly so.

The emergence period is long. Males are found from the end of April (Stalinabad) to the end of July (Kshtut), females from early May (Firyuza) to mid-September (Kvak), when a new generation is probably already emerging. According to Serkova's observations (1953) in the vicinity of Alma-Ata, the development of X. turanica from egg to adult insect took just under two months (from 7 July to 2 September). What little is known as regards the visitation of flowering plants by this species is summarized in the table below.

Despite the scantiness of our information on the feeding habits of X. turanica it can be assumed that this species, like the preceding one, is polytrophic. Very detailed

Table 1

Distribution of Xylocopa (Copoxyla) turanica F. Mor. on melliferous plants

Plant	Observation locality	Date of observation	Number of specimens	Observer
Malvaceae				
Lavatera thuringiaca L.....	Kvak, Gissar Range	13 Sept. 1946	– 1♂	V. Popov.
Althaea sp.	Chor-Tash, Fergana Range	30 June 1938	1♀ (p), 1♂	V. Popov.
Leguminosae				
Celtis siliquastrum L.	Stalinabad	29 April 1944	– 1♂	V. Popov.
Medicago sativa L.	nr. Alma-Ata	——	—	L. Serkova (1953).
Goebelia alopecuroides Bge.....	Koksengir, Karagadinsk prov.	14-25 June 1959	8♀ (2p), 5♂	Ye. Demyanova and A. Ponomareva
Verbenaceae				
Vitex agnus-castus L.	Stalinabad	20 June 1944	1♀ –	V. Popov.
Cruciferae				
Raphanus sp.	Stalinabad	21 May 1944	— 1♂	V. Popov.
Compositae				
Onopordon sp.	nr. Alma-Ata			L. Serkova (1953).
		21 May - 13 Sept.	10♀ (3 p), 9♂	

observations at Koksengir, on the other hand, showed that there the species is monotrophic; appearing as soon as Goebelia flowered, it ivisited only the flowers of this plant and was not observed after the plant had ceased to flower.

The species varies considerably as regards a number of characters. Some of the females are distinguished by structural details of the clypeus and mesonotum, the clypeus being flatter, finely or coarsely rugulosely punctate and the mesonotum as a rule less shiny. Such females do not form a distinct population but appear singly in Transilian Ala-Tau, Turkestan, the Gissar and Darvazsk ranges and elsewhere. In the Fergana range (Chor-Tash) a female of this kind was collected at the same time as a normal male on the same plant.

The species undoubtedly forms a distinct population in Transcaucasia and the adjacent parts of Iran (Nakhichevan, Tash). In the males the clypeus and lateral parts of the face are entirely light-colored. Light pubescence is much more abundantly developed: clypeus, lateral parts of the face, front and occiput almost completely light-colored; on the under side of the head below the genae there are tufts of light hairs; a light band on the ventral margin of the mesonotum runs across to the sides and base of the mesothorax, which are almost entirely covered with a light pubescence; the band on the first abdominal tergite is light-colored.

It is possible that this population forms a special subspecies, but factual data are still extremely inadequate.

Xylocopa (Copoxyla) sogdiana Popov et Ponomareva, sp. n.

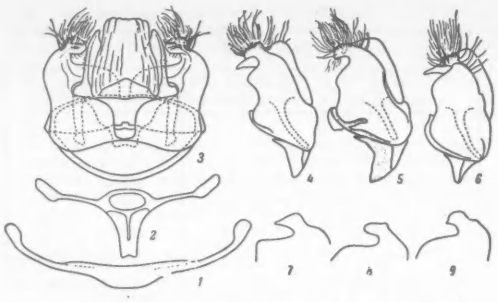
Xylocopa turanica F. Morawitz, Izv. Obshch. lyubit. yestestvoznan., antropolog. i etnograf., 19(2), 1875: 69♂ (nec ♀).

♂. Length 16.5-17.0 mm. Head slightly wider than long, broadly rounded at vertex; occiput slightly emarginate. Ocelli arranged in a wide triangle, distance between lateral ocelli at base of triangle equal to 2-2.5 times their diameter; distance between median and lateral ocelli equal to or slightly less than their diameter. Lateral ocelli set at a distance of 2.0-2.5 times their diameter from occipital margin. Frontal carina very poorly developed, passing into the ovate-oblong, non-punctate orbit of median ocellus. Clypeus very slightly convex, almost level, with a weak median punctate carina. Mandibles bidentate, upper tooth poorly defined, lower tooth almost as long as wide. Labrum broad, its length one third its breadth, and with a conspicuous longitudinal carina medially. Antennal scape long, slightly curved; 1st flagellar segment barely wider than long; 2nd segment shorter than the next three combined, these being almost equal to one another and slightly longer than wide; remaining flagellar segments conspicuously longer than 2nd to 5th. Hind tibiae normal, with two small, obliquely situated teeth in the form of a narrow trapezium medially on outer side; lower tooth slightly longer than upper. 7th sternite (Fig. 1) reduced to a very short fold with wider basal plates and a slightly broadened medial part. 8th sternite (Fig. 2) with more prolate basal plates and a narrow triangular medial part with concave sides and a narrow triangular apex. Copulatory organ (Figs. 3, 4) broad. Gonocardo reduced ventrally, slightly shorter than basal part of gonocoxites. Gonocoxites sturdy, broadly rounded at interodorsal angle, almost rectangular at interoventral angle, conspicuously concave laterally and dilated apically of the abruptly constricted distal part; distal part (undifferentiated gonostyle) conspicuously angularly dilated and prolate toward median line, densely covered with fairly long hairs. Sagittae greatly dorsoventrally, angularly reclinate and greatly constricted towards the sharp distal part; basal plates fairly short, thick and almost straight; plate connecting sagittae wide, almost trapezoidal.

Clypeus slightly shiny, densely rugulosely punctate, apically slightly more sparsely punctate, narrow irregular median line not punctate; lateral parts of face mat, very finely or densely rugulose punctate; occiput with large, sparser punctures; near each of the lateral ocelli glabrous, slightly shiny non-punctate surfaces, approximately equal in area to four ocelli; thick, coarse puncturation on temples. Mesonotum very slightly shiny, fairly thickly punctate on anterior third, distance between punctures not exceeding 1-2 times the diameter of the punctures; lateral parts of mesonotum a little more sparsely punctate; sparse punctures on middle of mesonotum and on scutellum, distances between them equal to 5-6 puncture diameters. Wing tegulae not punctate. 1st - 3rd tergites covered with fairly large punctures bearing hairs, the distance between them being 1-2 puncture diameters; 4-6th tergites with more shallow punctures; 5th-6th tergites, in addition to having such punctures, densely shagreened throughout.

Head and mesonotum black, abdomen with a violet hue, deep violet on 5th and 6th tergites; apical margins of 1st - 5th tergites narrowly discolored, somewhat alutaceous, wings lightly alutaceous with darker outer margins, a violet hue only on the dark margin.

Pubescence predominantly black; light hairs as admixture on face and occiput; "barrels," bottom of thorax and first abdominal tergite covered with



Figs. 1 - 9 - Species of the subgenus Copoxyla Maa, ♂. 1 - Xylocopa (Copoxyla) sogdiana, sp. n., 7th sternite; 2 - same, 8th sternite; 3 - same, copulatory organ in dorsal view; 4 - same, copulatory organ in lateral view; 5 - X. (C.) turanica F. Mor, copulatory organ in lateral view; 6 - X. (C.) iris Christ copulatory organ in lateral view; 7 - X. (C.) sogdiana, sp. n., distal part of gonocoxite in ventral view; 8 - X. (C.) turanica F. Mor., distal part of gonocoxite in ventral view; 9 - X. (C.) iris Christ, distal part of gonocoxite in ventral view.

light hairs; small tufts of light ciliae on sides of 2nd, 3rd and 4th tergites; head below and pubescence on legs, tergites and abdominal sternites black.

Tadzhikistan: Peter I range, Kamchirak pass, 22 June 1911, 1 ♂ (holotype) (A. Gol'bek).

The male of X. turanica F. Mor. was described from one specimen taken at Sangi-Dzhuman, Zeravshan range, Uzbekistan (Morawitz, 1875).

The species resembles X. turanica F. mor. but is sharply distinguished from it by having a completely black clypeus with finely rugulose sculpture, two teeth on outer side of hind tibia, light pubescence on the "barrels" and underside of the thorax and different structural details of the copulatory organ. The gonocoxites of the new species, viewed laterally, are characterized by an angularly prolate middle part and a greatly extended ventral distal part (Fig. 4). In X. turanica F. Mor. the middle part of the gonocoxites is broader, not ventrally prolate, and the distal part more rounded, not angular (Fig. 5). In X. iris Christ the middle part of the gonocoxites is also broader and less angular in lateral view, whereas the distal part is shorter, but thickened and rounded dorsally and ventrally, (Fig. 6). A number of further character differences in the configuration of the middle part of the gonocoxites and of their distal parts can be seen in ventral view, as shown in Figs. 7, 8 and 9.

Xylocopa (Xylocopa) afghanica Hed.

Xylocopa afhanica Hedicke, Deutsch. Entom. Zeitschr., 1938: 187 ♀.

This species had been known solely from typical females taken at Andarab in the Hindukush at altitudes of 4000-4500 m.

New material: Tadzhikistan, Kala-i-Vamar, 2200-2500 m, 8 and 31 August 1937, 2 ♀ (Ye. Luppova); Vanch, 2 September 1943, 2 ♀ (A. Shtakel'berg).

Maa (1954) wrongly took X. afghanica to be a synonym of X. varentzovi F. Mor. The form which he misidentified as the latter species is X. pseudoviolaceae Popov, as can be discovered with certainty from the sufficiently detailed description and the drawings of the copulatory organs of the males of both species. The female of that species is sharply distinguished from X. afghanica Hed. by the structure of the teeth on the outside of the hind tibiae.

Xylocopa (Nodula) punctilabris F. Mor.

Xylocopa punctilabris F. Morawitz, Horae Soc. Entom. Ross., 28, 1894: 24, ♂; Maidl, Ann. K. K. Naturhist. Hofmus. Wien, 26(3-4), 1912: 260 ♂; Popov, coll. "Ushchel'ye Kondara", 1951; 171 ♂.

Xylocopa (Nodula) bentoni Skll., Popov, Doklady Akad. Nauk SSSR, 58 (1), 1947: 171 ♀; Popov, Soobshch. Tadzhiksk. fil. Akad. Nauk SSSR, 7, 1948: 31 ♀ (syn. nov.). — Xylocopa (Nodula) punctilabris F. Mor., Maa, Vidensk. Meddel. f. Dansk. Naturh. For. i Kobenhavn, 116, 1954: 227, ♂.

The species was described from one male taken at Kshtut in the Zeravshan range, and subsequently was reported from "Eastern Iran" and Kondara in the Gissar range (1 male); the female, identified from the description with X. koltzschi Hed. (Hedicke, 1938), and so with X. bentoni Ckll. (Maa, 1938), was reported from Khodzha-Obi-Garm.

The practically simultaneous finding of 2 males of X. punctilabris F. Mor. at Khodzha-Obi-Garm (19 and 23 May 1944) (K. Romadin) and of the female mentioned (28 May 1944), also on "acacia" flowers, suggests that they belong to a single species.

The female, however, was described in considerable detail by Hedicke and in less detail by Maa; our specimen is not distinguishable even as regards the structure of the hind tibiae if we compare it with Hedicke's drawing. The sole distinguishing mark is the absence of a narrow, unpunctured median line on the clypeus, a character noted by both authors. A number of relevant characters will undoubtedly be found when females of the two species are ultimately subjected to direct comparison.

Comparison of the Central Asian males of X. punctilabris F. Mor. with Cockerell's description (1919) and with Maa's (1938, 1954) reveals a number of important distinctions: the abdomen of the Central Asian males lacks a bluish hue, the base of the mandible lacks a pale yellow spot, the inner orbits distinctly diverge upwards, the head is covered with black hairs (in X. bentoni Ckll. the cephalic hairs are partly light ocher), the thoracic dorsum is not light ocher but ocher, with darker hairs medially over a considerable area, the legs are covered with dark hairs (without light hairs on fore tibiae and tarsi, or on mid and hind legs), the abdomen is completely black (whereas in X. bentoni Ckll. the first three tergites are covered in light ocher hairs) and the wings are darker.

In his key to the X. punctigena Maa group (Maa, 1954), Maa was led into error by Morawitz's wrong diagnosis: in X. punctilabris F. Mor. the length of the 2nd flagellar segment exceeds that of the three following segments combined. The Morawitz species is nearest to bicristata Maa.

The copulatory organ of X. punctilabris F. Mor. shows a general similarity to the drawing of the X. bentoni Ckll. copulatory organ (Maa, 1938, Fig. 5), but is sharply distinguished by the shape of the undifferentiated gonostyles, which in the Central Asian species are greatly extended inwards at an angle to the median line of the genitalia, as in Copoxyla, and by the shorter and broader shape of the genitalia.

X. punctilabris F. Mor. is the sole representative of the subgenus Nodula in the USSR. In the Indian peninsula this subgenus is represented by 8 species (with 9 forms) and according to Ma (Ma, 1938) does not occur in the Australasian region or the eastern part of the Oriental region. Three species of it have been recorded in Afghanistan. The Mediterranean species belongs to the group X. punctigena Ma, which is characterized by well developed light spots on the face reaching the level of the lateral ocelli and by dense puncturation on the hind femora below. To this group belong X. punctigena Ma, X. bentoni Ckll., X. bicristata Maa and X. angulosa Maa.

Both Indian species are distributed, as far as we know today, in the Eastern Punjab, the Siwalik Range, the Nag-Toba Range and other adjacent ranges of the southern Himalayas, where they seem to be abundant and where X. bentoni Ckll. is known up to altitudes of more than 2500 m. In the Hindukush the species is known up to altitudes of 4000-4500 m. X. bicristata Maa and X. angulosa Maa have both been noted at the same time at an altitude of 1400 m in Nuristan. X. punctilabris F. Mor. has been captured at 1000-2000 m and its occurrence coincides with a forest region of walnut and maple formation rich in Tertiary faunal and floral relicts.

Although the female of "X. bentoni Ckll." has in fact proved alien to the Indian species it cannot be disputed that it belongs to the typical Indian subgenus, nor that this species — X. punctilabris F. Mor.— is correctly appraised

as a relict in the modern fauna of the Gissar Range, as well as in that of the Zeravshan Range, from which it was originally described.

Coporthosoma appendiculata (F. Sm.)

Primorskiy region, Hsiaots'angch'ang, 29 August 1946, 1 ♀ (M. Sukhova).

Widely distributed and common in China, Korea and Japan, where its modern northern boundary is situated; a new genus in the fauna of the USSR.

At present the Xylocopini fauna of the USSR consists of 19 probable species:[1] Xylocopa (Xylocopa violacea L., X. (X.) valga Gerst., *X. (X.) varentzovi F. Mor., *X. (X.) pseudoviolacea Popov, *X. (X.) afghanica Hed., X. (Copoxyla) iris Christ, *X. (C.) turanica F. Mor., *X. (C.) sogdiana Popov et Ponom., *X. (Nodula) punctilabris F. Mor., Proxylocopa (Proxylocopa) olivieri Lep., P. (P.) rufa Friese, *P. (P.) versicolor Alfk., *P. (P.) zonata Alfk., P. (Ancylocopa) nitidiventris altaica Popov, *P. (A.) morawitzi Per., *P. (A.) parviceps F. Mor., *P. (A.) pavlovskyi Popov, P. (A.) przewalskyi F. Mor. and Coptorthosoma appendiculata F. Sm. In addition, X. (Ctenoxylocopa) hottentota F. Sm. has been reported in Turkmenia, but this has still to be confirmed.

If we except Coptorthosoma, which has been reported only from the Primorskiy region, and Proxylocopa olivieri Lep., known from Cis-Caucasia, Transcaucasia and the Volga estuary, all the remaining species are in some degree connected with Central Asia and the contiguous parts of Kazakhstan.

It is interesting to compare this fauna with the fairly well studied fauna of India and Pakistan (Ma, 1938), which includes 16 known species (with 22 subspecies) of Xylocopa, 1 species of Proxylocopa, 7 species of Coptorthosoma, 1 of Cyanoderes, and 3 of Platynopoda. Only two species — Xylocopa valga Gerst. and Proxylocopa rufa Fries. are common to Central Asia, India and Pakistan. Only one species of the common Indian subgenus Nodula is found in Central Asia. All the remaining Xylocopa species belong to subgenera absent from Central Asia (Nyctomelitta, Biluna, Zonochirsuta) or not reliably recorded from there (Ctenoxylocopa). This is good confirmation of the endemism of a Xylocopini fauna in the two regions mentioned.

F. Morawitz (1875), describing the Xylocopa species known to him from Central Asia, was unable to find any endemic forms among them. Today, thanks to advances in taxonomy and better knowledge of the neighbouring areas, the endemism of Xylocopini species emerges very clearly. Of 17 Central Asian species, only two — X. (X.) violacea L. and X. (C.) iris Christ — penetrate to its borders in the Kopet-Dag, the second of these also occurring farther south, in north Kazakhstan. One species — Proxylocopa (Ancylocopa) przewalskyi F. Mor. — occupies the easternmost districts of Kazakhstan only in the western part of its modern area. The remaining 14 species are either endemic in Central Asia and its contiguous territories or are widely distributed throughout Central Asia (this is the case with X. (X.) valga Gerst.). Eleven species, marked with an asterisk in the list given above, can be named as endemic in this area. It is characteristic that the great majority of these are associated with foothill or mid-mountain belts.

Thirteen species of Xylocopa have so far been noted in Afghanistan (Maa, 1954): Xylocopa (Xylocopa) valga Gerst., X. (X.) convexior Hed., X. (X.) pseudoviolacea Popov (varentzovi Maa, nec. Mor.), X. (Ctenoxylocopa) basalis F. Sm., X. (Nodula) bicristata Maa, X. (N.) angulosa Maa, X. (N.) bentoni Ckll., X. (Copoxyla) iris Christ (probably another species of this subgenus), Proxylocopa (Proxylocopa) olivieri alticola Hed. (probably a separate species, or a subspecies of another species of this genus), P. (Ancylocopa) morawitzi Per., P. (A.) parviceps F. Mor., P. (A.) nix Maa and P. (A.) andabarana Hed.

If we except Xylocopa (Ctenoxylocopa) basalis F. Sm., found only in the extreme southeast of Afghanistan, the fauna of the rest of that country consists of genera, subgenera and some of the species characteristic of Central Asia. Maa rightly considers the Afghan Xylocopa fauna as partly Central Asian ("Turkmenian").

The peculiarity of this South Kazakh, Central Asian and Afghan fauna consists in the increasing number of species of the subgenera Xylocopa and Nodula to be found as one moves south, due to the appearance of Copoxyla and, in particular, Proxylocopa species. For both this subgenus and the genus, Central Asia is today an area of abundant species, despite the classic Mediterranean and Central Asian (or even mid-Asian) character that this region has acquired in modern times. One is inescapably led to the conclusion that Copoxyla and Proxylocopa are of native Central Asian (in the broadest sense of the term) origin. This inference is borne out by certain peculiar features of their biology.

The primordial coincidence of Xylocopini with the forest regions of the Earth's tropical and subtropical belts and their age-old ecological ties with tree and scrub vegetation both as pollinators and as species breeding in dry and dying wood — propositions advanced at the beginning of this paper — are obvious. It is known, however, that species of the genus Proxylocopa nest in the ground, emerging after sunset and nesting preferably in open desert sites. Copoxyla species, it has been discovered, build their nests in the stems of coarse grasses and infest steppe sites.

A characteristic feature of the two groups in question is their lack of particularly large forms, the steppe forms being the smallest. The trophic relationships of these groups have, of course, been extremely inadequately studied as yet; nevertheless, there are so far no observations indicating damage by species of these groups to flowers visited by them or suggesting that they "bite through" deep flowers in which the nectar is inaccessible to bees by normal visitation. As the observations in Tadzhikistan have shown, Proxylocopa rufa Friese is oligotrophic, pollinating primarily the flowers of Capparis spinosa; Proxylocopa pavlovskiy Popov pollinates mainly Incarvillea olgae, and Xylocopa (Copoxyla) turanica F. Mor. in Central Kazakhstan, Goebelia alopecuroides. All this constitutes some indication of a fuller correlation with the local flora than has been noted in regard to the common palaearctic polytrophic species Xylocopa violacea L. and X. valga Gerst., which prefer introduced plants, trees and shrubs (Popov, 1947).

The relationship between Xylocopini and flowering plants has been little studies as regards the tropics. Only fragmentary information on many, or even most, of the species is available. The majority seem to be polytrophic, although associated with plants with fairly large, deep flowers. Platynopoda latipes (Sm.), for example visits plants of many families (Acanthaceae, Zingiberaceae, Leguminosae, Convolvulaceae, Orchidaceae) in Java, and is the sole pollinator of some of these (Pijl, 1954). As we now know, however, a number of Xylocopini species also pierce flowers to obtain nectar, in the tropical zone as well. Coptorthosoma confusa (F.) and Cyaneoderes coerulea (Per.) are important Ipomea crassicaulis pollinators in Java. A small number of bees managed the pollination excellently; all the flowers were visited several times and fructified well. Instances are known of a young bee having first visited the flowers in the normal manner and later started to pierce the corolla tube with its maxillae.

In the vicinity of Yalta (Crimea), V. V. Popov observed incidents of the same order on 9 and 16 June 1952. Flowering bushes of the garden form of honeysuckle (Lonicera) with very large pale yellow flowers, growing alongside a road, were visited by Xylocopa violacea L. along with other flowering plants (garden flowers, oleaster). The insect pierced the tube with a light thrust of the extruded maxillae, gently opening it to a depth of about one centimeter. The bee then settled on the flower in such a way that the abdominal extremity, completely covered with pollen, was touching the stamens and pistil projecting from the corolla. The tarsi clasped the tube. A broader place for pricking the corolla is nearer the apex of the flower, which rapidly narrows towards its base. The observations showed that Xylocopa never obtained nectar in the normal way, always pricking the flower. Its openings were then used by domestic bees, which had also visited the honeysuckle in abundance, the fresher, unpierced flowers being visited in the normal way. A count made on 16 June showed that of 148 flowers examined 40 had not been injured by Xylocopa, 53 had each one puncture, 48 had two punctures and 7 had three. This gives grounds for believing that Xylocopa does not use the puncture made by its predecessor but when visiting a flower which has already been injured, makes a new opening.

[1] Asterisk indicates species endemic in Central Asia and neighbouring territories.

The reasons why flowers are punctured by certain palaearctic Xylocopini therefore call for more precise investigation and, above all, for accurate records of such cases for the purpose of subsequent examination.

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A NEW SPECIES OF THE GENERA TRISOPSIS KIEFF. ANDTRIOMMATOMYIA, GEN. N. (DIPTERA, ITONIDIDAE)

B. M. MAMAYEV

The species described in this paper belong to a specific group of gall midges in which the compound eyes coalesce on the vertex and are medially interrupted by a strip without facets. The eyes thus consist of three groups of facets, one on the vertex and two ventrally. Nearly all the "triocular" species of gall midges hitherto described belong to the genus Trisopsis Kieff.

A second genus, Triommata Barnes, only one species of which is known at present, T. coccotroctes Barnes, is readily distinguished from Trisopsis by details of structure, including such important characters as the number of palpal segments and the structure of the claws.

By collecting midges developing in decaying wood I succeeded in rearing a good number of adult specimens of a species belonging to a new genus, similar to Triommata Barnes. This is described below.

TRIOMMATOMYIA Mamayev, gen. n.

Compound eyes coalescent on vertex and medially interrupted by a strip without facets.

Antennae 2 +12, 3rd and 4th segments fused. Flagellar segments of male binodular. Lower nodule of each flagellar segment rounded, upper nodule pear-shaped, with a slight constriction medially. A circumfilum on lower nodule consists of 10 loops, 9 of which are uniform and short, their length not exceeding the width of the lower nodule; 10th loop very long, running almost at right angles to axis of segment, its length 6-7 times the width of the nodule. Upper nodule bears 2 circumfili. Within each whorl the loops are of uniform length. In addition, each antennal segment bears two whorls of stout hairs, one on each nodule. Flagellar segments in female petiolate. Two whorls of stout hairs basally and apically on thickened part of antenna. Terminal antennal segment cylindrical, smoothly rounded at apex.

Palpi 4-segmented. Wing has 3 longitudinal veins, the radius entering the costal at the wing tip; cubital vein with bifurcation.

Tarsi covered with dense scales. Claws rectangularly inflexed; claw of fore tarsus with a tooth basally, those on mid and hind tarsi simple.

Hypopygium with sturdy gonocoxites; these have a median, spiniform process basally, a good deal less sclerotized than in Trisopsis Kieff. species. Gonostyles short, well-proportioned; dorsal plate bilobed, ventral plate circular. Gonofurca styletiform. Ovipositor short, with two terminal plates.

The genus belongs to the Trifila group of the subfamily Itonidinae. It is clearly distinguished from the related genus Triommata Barnes by the long circumfilar loop on the lower nodule of the antennal segment (in Triommata all the circumfili and all the loops forming them are of the same length) and by details of the hypopygial structure.

Generic type: Triommatomyia barnesi, sp. n.

Triommatomyia barnesi sp. n. (Fig. 1).

Brown; body length 2.0 mm; male antennae the same length. Width of facetless eye strip roughly one third the overall length of the eye. Lower petiole of antennal segments in male conspicuously shorter than upper. Upper segmental nodule with a pronounced constriction. The upper of the two circumfili on it almost twice as long as the lower. Length of petioles of female antennal segments one fourth the overall length of the segments. 1st palpal segment very short, 2nd, 3rd and 4th all the same length. Wings densely covered with hairs. 2nd tarsal segment the largest, its length exceeding the combined length of the 3rd, 4th and 5th segments; 3rd segment half as long again as 4th and 5th half as long as 4th. Femora evenly covered below with a series of 13-15 long setae. Pulvilli slightly longer than claws.

The adult gall midges were reared from orange-colored, barely mobile larvae, obviously mycetophagous, found in large quantity in the soft light wood of a beech stump near the settlement of Novo-Prokhladnoye in the Krasnodar area in May 1959.

Holotype: male, mount no. 557, larvae in wood of beech stump, Novo-Prokhladnoye, Krasnodar, 18 June 1959. Cotypes: 7 males and 6 females, mount no. 557a.

The species is named after H. F. Barnes, the well-known authority on gall midges, whose work was interrupted by his untimely death in 1960.

TRISOPSIS Kieff.

The genus Trisopsis Kieff. also belongs to the Trifila group but cannot be regarded as related to Triommata Barnes and Triommatomyia, gen. n., since representatives of these genera differ from it in such cardinal systematic characters as the number of palpal segments and the structure of the claws and hypopygium. It seems that the reduction of compound eye facets has occurred independently in taxonomically distant groups of gall midges.

Representatives of the genus Trisopsis, as of all gall midge groups whose larvae live outside galls, have been little studied. Nevertheless it is evident both from published material and from other material available to the present author that the genus Trisopsis is widely distributed and rich in species. Representatives of it are known from Europe, Asia, Africa and America.

Generic type — Trisopsis oleae Kieffer, described in 1912 from the vicinity of Wellington (S. Africa). In 1913 the same author described T. alluaudi from Kenya. A third species, T. bifida Brethes, was captured in Buenos Aires and described in 1915. A fourth, T. hyperici Tavares, was described from Spanish material in 1919 (Pontevedra). A fifth, T. hibicis Felt, and a sixth, T. travancoricus Nayar were described from North America (Louisiana, 1935) and India (Trivandrum, 1949). Barnes's paper (1951) contains the description of a seventh species of this genus, T. tyroglyphi Barnes, based on material from the Leningrad province sent to England by Ye. V. Dombrovskaya. An eighth and last species, T. karelini Mar., was described in 1958 by P. I. Marikovskiy from a series of gall midges taken in daylight near Alma-Ata.

So far, then, only two Trisopsis species have been described from European material. I have managed to collect seven additional new species of this genus. In the

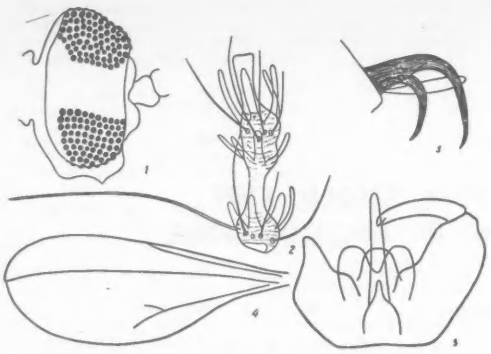

Fig. 1 - Structural details of Triommatomyia barnesi, gen. et sp.n. 1 - head, lateral view; 2 - 6th flagellar segment of male; 3 - claw on front tarsus; 4 - wing; 5 - hypopygium.

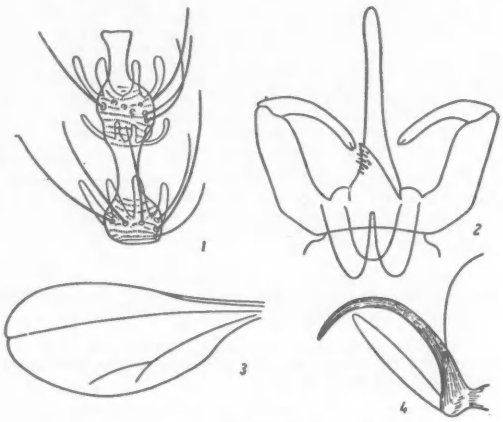

Fig. 2 - Structural details of Trisopsis longitarsis sp. n. 1 - 6th flagellar segment of male; 2 - hypopygium; 3 - wing; 4 - tarsal claw.

descriptions given below attention has been directed primarily to characters which can be used as bases for distinguishing the species, since the common generic characters can be found described in some detail in Soviet and foreign published papers (Marikovskiy, 1958; Kieffer, 1913).

Trisopsis longitarsis, sp.n. (Fig. 2).

Yellow; body length 1.7 mm, antennae slightly longer than body. The width of the facetless eye-strip can vary. Its formation is accompanied by underdevelopment of some of the transverse rows of facets (one to four of them, according to the specimen). On each flagellar segment the petiole is slightly longer than the lower nodule; all circumfili are roughly the same length. The legs are long, almost twice as long as the body. Femur and tibia are of equal length; 5th segment of hind tarsus half the length of 4th; claws falcate; pulvilli the same length as claws. Wings the same length as body, bifurcation of cubital vein distinct, its branches almost reaching the margin of the wing. Hypopygium with well-proportioned gonocoxites, each of which has a circular pad basally; gonofurca very long, extending well beyond the line joining the apices of the gonocoxites.

Four males of this species were captured in the Krasnodar area in June 1953. Holotype: male, mount no. 558, captured in the Ubinsk forestry, Krasnodar region, on 20 June 1953. Cotypes: 2 males, mount no. 558a.

Fig. 3 - Hypogium Trisopsis abdominalis, sp.n.

Fig. 4 - Hypogium Trisopsis vulgaris, sp.n.

Trisopsis abdominalis, sp.n. (Fig. 3).

Brown; body 2.0 mm long. Facetless eye-strip the width of a double row of facets. In the dorsal part of the eye the facets are arranged more loosely. Abdomen almost three times longer than thorax. Wings slightly shorter than body, densely covered with hairs, branches of cubital vein indistinct. Legs only just longer than body. Femur longer than tibia; 4th and 5th tarsal segments of equal length. Claws falcate, pulvilli the same length as claws. Hypopygial gonocoxites well-proportioned, with a tooth in basal third and a series of spines on the inside. Gonostyles half as long as gonocoxites. Spiniform process at base of gonocoxite dark-alutaceous with a series of black spines terminally. Dorsal plate bilobed, ventral plate ellipsoidal, slightly longer than dorsal. Gonofurca styletiform, extending slightly beyond the line joining the apices of the gonocoxites.

Described from two males, one of which was reared from a larva found in the Tula national forest in decaying wood of an oak log (brown rot, caused by the fungus Polyporus sulphureus) and the other captured at Bykovo, Moscow province, in July 1960.

Holotype: male, mount no. 559; larvae in rotting oak wood in the Tula national forest, 7 July 1958.

Trisopsis vulgaris, sp.n. (Fig. 4).

Yellow-brown; body length 1.0-1.2 mm. Facetless eye-strip narrow, the width of a double row of facets. Antennae longer than body. Each flagellar segment consists of a rounded lower nodule, slightly oblate dorsoventrally, and a larger, pyriform upper nodule. These are joined by a petiole slightly shorter than the one joining the segment to the next. Circumfili equal in size, stout hairs below them basally. Abdomen with a dark inner patch and slightly longer than thorax. Wings as long as body, branches of cubital vein indistinct. Legs longer than body. 2nd tarsal segment the largest, equal in length to 3rd, 4th and 5th combined. Claws falcate, pulvilli of the same length as the claws. Hypopygial gonostyles half as long as gonocoxites, echinate process at bases of gonocoxites, apically reaching the middle of the gonofurca. Dorsal plate bilobed, ventral plate of the same length as the dorsal and smoothly rounded. Gonofurca linear with rounded apex covered with light dots.

One of the commonest species in the "Glubokoye ozero" biological station area (Moscow province). Described from a large series of specimens.

Holotype: male, mount no. 560, captured at the "Glubokoye ozero" biological station of the Institute of Animal Morphology near Moscow on 20 July 1960. Cotypes: 2 males, mounts no. 560a and 27 males in alcohol.

As regards hypopygial structure T. vulgaris, sp.n. resembles T. karelini Mar. (Fig. 5) but is easily distinguished from the latter by its smaller size, relatively short gonostyles, longer echinate process, series of small spinelets at the bases of the gonocoxites and details of antennal structure (the segmental petioles are all the same length in T. karelini Mar.).

Trisopsis acicularis, sp.n. (Fig. 6).

Fig. 5 - Hypopygium Trisopsis karelini Mar.

Fig. 6 - Hypopygium Trisopsis acicularis, sp.n.

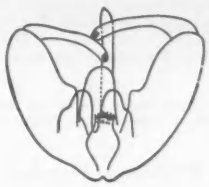

Fig. 7 - Hypopygium Triopsis punctiventris, sp.n.

Fig. 8 - Hypopygium Trisopsis globularis, sp.n.

Brown, body 2.0 mm long. Facetless eye-strip the width of a triple row of facets. Male antennae half as long again as body. Lower nodules of flagellar segments circular; upper nodules pyriform, conspicuously larger than the others. Petioles of flagellar segments all the same length, which conspicuously exceeds that of the lower nodule of the segment. Circumfili of equal length, with stout hairs twice as long as the circumfili at base of 1st and 3rd whorls. Abdomen twice as long as thorax, with a dark inner patch. Wings of the same length as body, densely covered with hairs; branches of cubital vein indistinct. Legs longer than body and thickly covered with scales. Femur longer than tibia, 5th tarsal segment shorter than 4th. Claws falcate, pulvilli of the same length as claws. Hypopygium with narrow well-proportioned gonocoxites; gonostyle slender, two thirds the length of gonocoxite. Echinate process at bases of gonocoxites relatively long, bottle-shaped, with stout spines densely placed in distal part. Dorsal plate bilobed, with rounded pads. Ventral plate of the same length as dorsal, smoothly rounded apically, with a prominence on either side. Gonofurca lanceolate, terminally acuminate. The collection contains females of this species, but it is not possible to detect sufficiently clear distinguishing characters in them.

A large number of specimens was captured at the "Glubokoye ozero" station.

Holotype: male, mount no. 561, captured at "Glubokoye ozero" biological station near Moscow on 20 July 1960. Cotypes: 4 males, mounts 501a.

Trisopsis punctiventris, sp.n. (Fig. 7).

Yellow, with a large black inner patch on anterior third of abdomen. Body 1.5 mm long. Facetless eye strip occupies one third the area of the compound eye. Petiole of male antennal segments half as long again as lower nodule of segment; circumfili of approximately equal length. Wings slightly longer than body. Radial vein, with conspicuous flexure, meets margin directly behind wing apex. Cubital branches distinct, reaching the wing-margin. Legs half as long again as body. Femur longer than tibia; tibia equal in length to 1st and 2nd tarsal segments combined. Claws falcate, light in distal third, black in proximal part. Pulvilli slightly shorter than claws. Gonocoxite with internal prominence medially; gonostyles half as long as gonocoxites. Dorsal plate with deep excision, ventral plate linear with rounded apex; gonofurca acicular, extending slightly beyond the line joining the apices of the gonocoxites. Apex of echinate process at bases of gonocoxites truncated.

Four males of this species were captured at Pavlovaya Sloboda, Moscow province.

Holotype: male, mount no. 562, captured at Pavlovaya Sloboda, Moscow province, on 23 June 1960. Cotype: 1 male, mount no. 562a.

Trisopsis globularis, sp.n. (Fig. 8).

Brown, body length 1.0 mm. Facetless eye-strip one third the width of the compound eye. Antennae slightly longer than body. Flagellar segments sturdy, with thick, short petioles and rounded nodules. Petiole two fifths the diameter of the nodules in thickness, shorter than upper nodule and roughly of the same length as lower nodule. Circumfili equal in size. Abdomen and thorax equal in length. Wings conspicuously longer than body, "costal-vein" (sic) branches very conspicuous. Tibia slightly shorter than femur; 4th tarsal segment only slightly longer than 5th. Claws falcate, pulvilli the same length as the claws. Hypopygium with sturdy gonocoxites, gonostyles a little more than half as long as gonocoxites. Spinelike process at base of gonocoxite short, only slightly sclerotized and without strong spines. Dorsal plate with deep excision and rounded lobes, ventral plate broad and shorter than dorsal,

Fig. 9 - Hypopygium Trisopsis macrolobis, sp.n.

Fig. 10 - Hypopygium Trisopsis tyroglyphi Barnes.

with straight margin. Gonofurca not extending beyond line joining apices of gonocoxites.

A single male of this species was captured in the Moscow province (Bykovo settlement).

Holotype: male, mount no. 563, captured at Bykovo, Moscow province, 20 July 1960.

Trisopsis macrolobis, sp.n. (Fig. 9).

Basic color of body brown; body 1.2 mm long. Facetless eye strip one fourth the length of the compound eye. Both nodules of antennal segments in male regularly globate. Lower nodule slightly smaller than upper; petioles of equal length. First circumfilum, counting from apex of segment, slightly longer than the other two, which are equal in length. Each nodule bearing rather long, strong, black hairs. Abdomen short and distended. Wings conspicuously longer than body. Long branch of cubital fork reduced. Legs slightly longer than body; 2nd tarsal segment equal in length to 3rd, 4th and 5th combined. 4th segment of hind tarsus longer than 5th. Claws falcate; puvilli equal in length to claws. Gonocoxites sturdy, with large basal lobes interiorly; these covered with short, dense hairs. Gonostyles slightly shorter than gonocoxites. Echinate process at bases of gonocoxites pitcher-shaped and lacking the strong spines characteristic of a number of other species. Dorsal plate bilobed, with acuminate lobes; ventral plate shorter than dorsal, resembling a square with rounded corners. Gonofurca acicular, extending beyond the line joining the apices of the gonocoxites.

Described from one male and two females captured at Bykovo, Moscow province.

Holotype: male, mount no. 564, captured at Bykovo, Moscow province, on 20 July 1960.

The author's collection also contains specimens of T. tyroglyphi Barnes. As the hypopygial structure is the most

reliable criterion for distinguishing between Trisopsis species, a drawing of the T. tyroglyphi hypopygium is given (Fig. 10), that species having been found in Soviet territory. The literature, however, contains no drawings from which it can be reliably identified.

The types of the species described above are in the Institute of Zoology (Academy of Sciences, USSR) collections, the cotypes in the author's collection.

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NEW AND RARE PALAEARCTIC SPECIES OF THE GENUS SPONGOSTYLUM MACQ. (DIPTERA, BOMBYLIIDAE)

V. F. ZAYTSEV

In the present paper I have kept to Paramonow's interpretation of the genus Spongostylum and of the species groups within that genus, nine in all (Paramonow, 1957). We have at our disposal five new species belonging to the isis group, from Transcaucasia. In addition, this paper contains descriptions of the hitherto unknown males of three species of the kozlovi group from the Pamirs and redescriptions of the species Spongostylum isis Meig. and Spongostylum kozlovi Param. All the types of the new species are kept, unless otherwise stated, in the Leningrad collections of the Academy of Sciences, USSR, Institute of Zoology.

My thanks are due to A. A. Shtakel'berg for directing the work.

Spongostylum isis Meig.

Meigen, 1820: 164, 35 (Anthrax); Sack, 1909: 537 (Psamatamoeba); Kertesz, 1909: 65 (Argyramoeba); Austen, 1937: 129; Engel, 1937: 445, Textfig. 183 and 184.

Syn. binotata Meig.; ixion Meg.; subnotata Walk.

As regards hypopygial structure the species most resembles Spongostylum caucasicum, from which it is distinguished by the upwardly bent apex of the epiphallus, which has the form of a falcate plate, by the terminally rather broad phallus and by the broadly curved apices of the gonostyles (Figs. 1-4). As regards external characters, the species is distinguished by the reddish-black color of the two basal antennal segments, the presence of infuscate spots on the wing at the base of the radius and on rm and mcu and the presence of white hairs on the coxae alone.

♂. Body grayish-black mat. Hairs on frons black, white on face; frontal and facial scales white. Ocellar tubercles set back from eye margins at a distance slightly greater than their width. The two basal antennal segments reddish-black or reddish-alutaceous, with white hairs. 3rd antennal segment black, bulbous, its slender apical part (without style) in the ratio of 7 : 5 to the thickened base, the style shorter than the slender apical part by nearly a half. Occiput covered with light hairs and scales. Collar of white hairs. Surface of mesonotum and scutellum with short, black hairs and yellowish scales, the latter becoming pure white along the sides of the mesonotum and the posterior margin of the scutellum. Setae, in front of wing-bases black; light setae as well as black on postalar calli and scutellum. Pleura and coxae with white hairs and scales. Femora black, only their apices yellow; tibiae yellow. Scales on legs white, setae black. Pulvilli of same length as claws. Costal hook yellow, base of costa with light scales. Wings hyaline, with alutaceous patches at base of radius, on rm, situated at end of basal third of the discoidal cell, and also on mcu. Veins r_{2+3} and r_4 with spurs. Squama light, with white hairs. Halteres alutaceous to yellow with white knobs. Plumula white. Hairs on 1st tergite and sides of abdomen white, surface of tergites covered with yellow, yellowish alutaceous and white scales and black, erect hairs. A band of long, white, hairlike scales extends along posterior margin of 1st tergite. In well preserved specimens there are slightly diffuse patches and bands of alutaceous scales on 2nd tergite. Broad white scales are concentrated on posterior margins of tergites; on 5th and 6th tergites they take up nearly the entire surface, leaving only a small band medially. Sternites with white hairs and scales.

Epandrium[1] with an almost straight distal margin. Cerci round, with simple pubescence. Epiphallus and phallus arcuately curved. Distal end of epiphallus in the form of a sickle-shaped plate; a small, broad spine on upper surface of epiphallus, near the middle. Blunt apex of phallus bent downward and slightly dilated. Gonocoxites with rounded distal apices. Gonostyle stout, curved, with dilated base and curved, slightly inclined, sharp apex (Figs. 1-4).

♀. Exactly similar to male, distinguished only by broader frons.

Body length 7-11 mm, wings 7-10.5 mm.

General distribution: USSR — Transcaucasia, Central Asia; southern Europe, Asia Minor, North Africa.

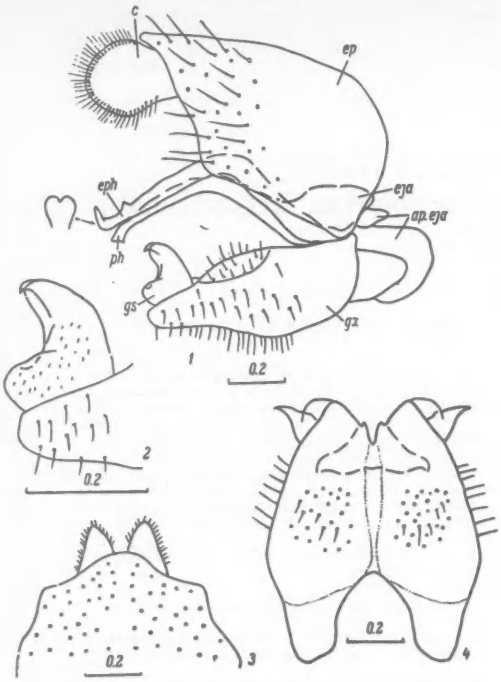
The species is widely distributed in the lowland part of Transcaucasia (particularly the semi-deserts). It occurs in dry places with sparse vegetation, on the ground, on rocks, large stones and along roads.

Spongostylum caucasicum, sp. n.

In the structure of the hypopygium this species is very close to Spongostylum isis, from which it differs in having the apex of epiphallus bent upward, forming a prolate rounded plate, and the apex of gonostyle not curved but having a short, upright, digitiform process (Figs. 5-8). The external characters typical of the species are white hairs on the coxae of all the legs, the presence of black and light setae on thorax and scutellum and the presence of alutaceous patches on the wings only at the base of the radius and on vein rm.

♂. Body grayish-black and mat. Hairs on frons black, those on face white. Frontal and facial scales yellow and white. Ocellar tubercle set at a distance from margins of compound eyes equal to its own width. Antennae black with light hairs. Third antennal segment bulbous; ratio of slender apical part of 3rd segment (without style) to thickened base 2 : 3; style a little more than half as long as slender apical part of segment. Occiput with white hairs and scales, which become yellow towards the center of the occiput. Collar of white hairs. Surface of mesonotum and scutellum covered with short, black hairs and white and yellow scales; in fresh specimens the latter may be arranged in longitudinal bands. The hairs and scales on the sides of the mesonotum and the posterior margin of the scutellum form white bands. Thoracic and scutellar setae black and yellow;

[1] In males of the genus Spongostylum the hypopygium is usually rotated 180° from left to right. We are using the terms "dorsally", "ventrally" and "laterally" without reference to the degree of rotation of the hypopygium; that is, the dorsal side is always the one on which the 9th tergite (epandrium) is situated, the ventral side the one on which the 9th sternite (hypandrium) is situated. The terminology for the hypopygial parts is that given by Emden and Hennig (1956).



Figs. 1 - 4 - Spongostylum isis Meig. Figs. 1 - 38 illustrate the following characters (each species): gonostyles, hypopygium (laterally), distal half of epandrium (dorsally), gonopods (ventrally); c - cercus, ep - epandrium, eph - epiphallus, ph - phallus, eja - ejaculator, ap.eja - apodemes of ejaculator, gs - gonostyles, and gx - gonocoxites.

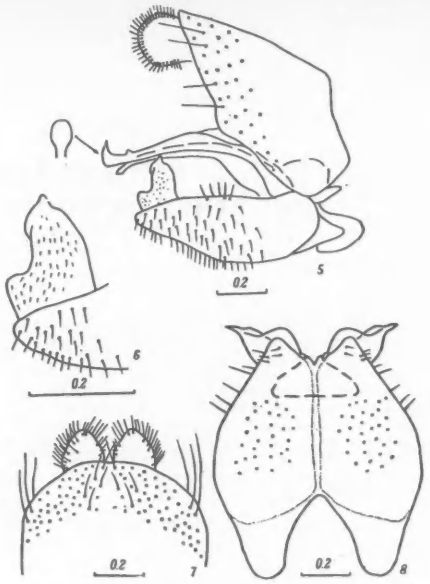
in some specimens the setae on the posterior margin of the scutellum may be either all white or all black. Pleura and coxae with white hairs and scales. Femora black, tibiae alutaceous to yellow. Leg setae black, scales light. Pulvilli as long as claws. Costal hook yellow; base of costa covered with yellow and white scales. Wings hyaline; infuscate circular patches at base of radius and on vein rm, which is situated a littled basad of the middle of the discoidal cell. Short adventitious spurs on r_{2+3} and r_4. Squama white, with white hairs. Halteres alutaceous to yellow, with white knobs. Plumula white. Abdominal hairs white, forming thick tufts laterally on 1st tergite. Tergital surface covered with yellow scales and, nearer to posterior margin, black setae. Bands of white scales extend along posterior margins of all tergites; on 1st tergite these scales are hair-like and particularly long and dense, forming a fairly broad, white belt. 7th tergite and sides of 5th and 6th almost continuously covered with white scales. Sternites with white hairs and scales.

Distal margin of epandrium rounded. Cerci of usual shape, covered with hairs. Sclerites only slightly chitinized, with indistinct borders. Epiphallus long and narrow, the distal extremity bent upward, forming a prolate, circular plate. There is also a small spine dorsally on the epiphallus. Phallus blunt, the apex curved downward. Ejaculator and its apodemes small. Gonocoxite with a small rounded protuberance on distal extremity. Gonostyle fairly stout throughout its length, with dilated base and digitiformly prolate at the extremity (Figs. 5-8).

♀. Similar to male except for broader frons.

Body length 9-11 mm, wings 8.5-10 mm.

Holotype: ♂ in cop., Armenia, Vedi, sand, 10 August 1959 (V. Zaytsev).



Figs. 5 - 8 - Spongostylum caucasicum, sp. nov. (mount 771).

Allotype: ♀ in cop., Armenia, Vedi, sand, 10 August 1959 (V. Zaytsev).

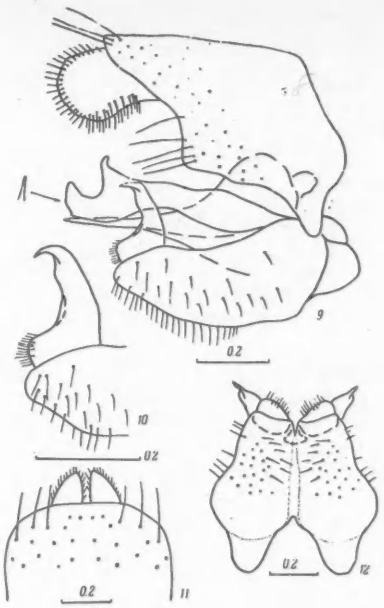
Paratypes: Armenia, 1 ♂ and 3 ♀, Vedi, sand, 10 August 1959 (V. Zaytsev); 1 ♂ and 1 ♀, Asni, nr. Arazdayan st., 12 August 1959 (V. Zaytsev); 1 ♂, Karmir-Blur, nr. Yerevan, 23 June 1955 (V. Zaytsev); 1 ♂ Davalu, Araks valley, 25 July 1928 (preserved in Institute of Zoology, Armenian Academy of Sciences, Yerevan).

Spongostylum dubium, sp. nov.

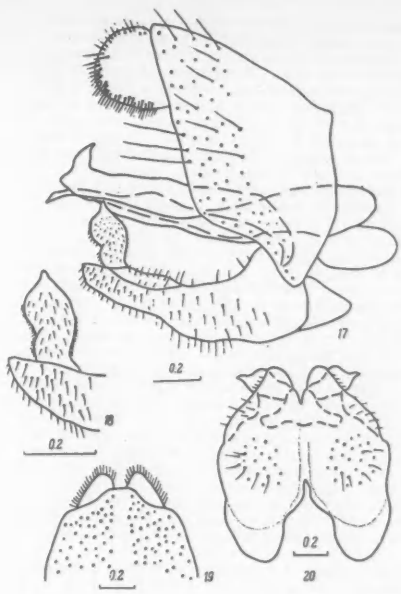
In hypopygial structure this species resembles Spongostylum cinereum, sp. n., from which it is distinguished by the cariniform apex of the epiphallus and the strongly curved apex of the gonostyle (Figs. 9-12). Of the external characters, the following are typical of S. dubium, sp. n.: coxae with white hairs only, wing patches at base of radius and on rm, 2nd abdominal tergite, with a tuft of alutaceous scales and hairs.

♂. Body grayish-black, mat. Frontal hairs black, facial hairs white. Frontal and facial scales yellowish-white. Ocellar tubercle set at a distance equal to its own width from margin of compound eye. Antennae black; 1st segment with black hairs dorsally and white hairs ventrally; 3rd segment bulbous, its dilated base in the ratio of 5 : 4 to the slender apical part (without style), style itself only a little more than half as long as slender apex of 3rd segment. Occiput covered with light hairs and scales. Collar of white hairs. Mesonotal and scutellar surface with short, black hairs and yellow scales; hairs and scales becoming light, almost white, on sides of mesonotum and posterior margin of scutellum. Thoracic and scutellar setae black, with admixture of yellow. Pleura and coxae with white hairs and scales.

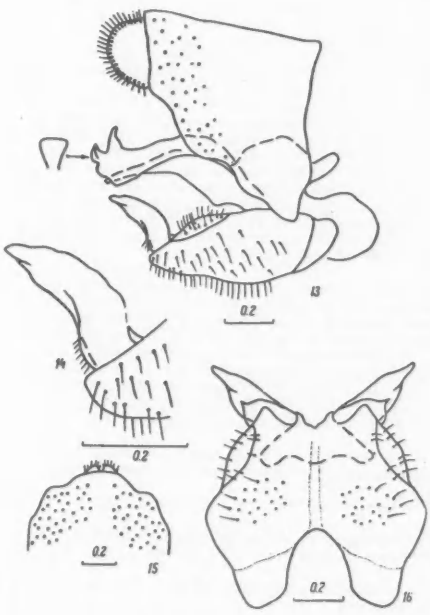
Femora black, tibiae yellow, leg scales and hairs light, setae black. Pulvilli as long as claws. Costal hook yellow, base of costa with yellow scales. Wings hyaline, with dense alutaceous patches at base of radius and on rm and a weak, barely noticeable spot on mcu. Adventitious spurs on r_{2+3} and r_4. Squama light, with white hairs. Halteres alutaceous with white knobs. Abdominal hairs white, with dense tufts on sides of 1st



Figs. 9 - 12 - Spongostylum dubium, sp.nov. (mount 779).



Figs. 17 - 20 - Spongostylum punctipenne, sp. nov. (mount 789).



Figs. 13 - 16 - Spongostylum cinereum, sp.nov. (mount 788).

tergite. Long alutaceous scales, forming conspicuous bundles, on sides of 2nd and 4th tergites in addition to white hairs and scales. Surface of tergites covered with yellow scales. Long, black erect hairs along posterior margins of tergites, which also have bands of white scales. Owing to the poor state of preservation of the specimens it is not possible to give a more detailed description of the abdomen. Sternites covered with white hairs and scales.

Epandrium large, with an almost rectangular lateral margin. Cerci round, with a group of coarse, seta-like hairs on lower margin; remaining hairs simple. Sclerites narrow and rod-shaped. Epiphallus dorsally with two stout, curved spines, of which the distal one is blunter and much less sclerotized. Only the extreme tip of the phallus extending beyond the epiphallus. Ejaculator large, apodemes small. Distal extremity of gonocoxites without protuberances, rounded. Gonostyle with dilated base and narrow, very acuminate apex which is bent downward, in lateral view (Figs. 9-12).

♀. Exactly like male except for broader frons.

Body length 9-10 mm, wings 8-9 mm.

Holotype: ♂, Armenia, Vedi, 9 August 1959 (V. Zaytsev).

Allotype: ♀, Azerbaydzhan, Siazan', August 1938 (Trofimov).

Paratypes: 1 ♂, Azerbaydzhan, Siazan', August 1938 (Trofimov); 1 ♀, Armenia, Vedi, 9 August 1959 (V. Zaytsev).

Spongostylum cinereum, sp. nov.

Resembles Spongostylum dibium in hypopygial structure but differs as regards structure of epiphallus and gonostyles. Apex of epiphallus not spiniform but dorsally curved upward to form a wide, thick plate. Gonostyles almost the same width throughout their length, their apices straight instead of bent downward (Figs. 13-16) as in S. dubium. The external characters typical of this species are the reddish-black antennae, the presence of only black setae on thorax and scutellum and of white hairs with no black admixtures on coxae and the tufts of alutaceous hairs and scales on sides of 2nd tergite.

♂. Body grayish-black, mat. Frons with black hairs, face with white. Frontal and facial scales light. Ocellar tubercle set at a distance from

compound eye equal to its width. Antennae reddish-black, or reddish-alutaceous in some specimens. First antennal segment with black hairs dorsally and white hairs ventrally. Third antennal segment bulbous, its slender apical part (without style) in ratio of 2.5:3.5 to thick base; style half to two-fifths as long as apical part of 3rd antennal segment. Occiput covered with light hairs and scales. Collar of light hairs. Mesonotum and scutellum with white and yellow scales and short, black hairs. All setae on thorax and scutellum black unless there are isolated light ones. Hairs and scales on pleura and coxae white. Femora alutaceous, tibiae alutaceous to yellow. Leg hairs and setae black, scales light. Pulvilli as long as claws. Costal hook yellow, base of costa with light scales. Wings hyaline. Alutaceous spots on radius, basally, and on vein rm, which lies basad of the middle of the discoidal cell. Very slight, barely perceptible infuscation also on mcu. There are invariably adventitious spurs on r_{2+3} and r_4. Squama light, with white hairs. Halteres alutaceous with white capitellum. Plumula white. First abdominal tergite with dense white hairs. Sides of abdomen with white hairs and scales, except for a conspicuous tuft of long, alutaceous, scale-like hairs on sides of 2nd tergite. Surface of tergites with black erect hairs and yellow and white scales. The white scales are concentrated basally on posterior margins of tergites, becoming so dense and broad from the 4th tergite onward that they take up nearly the entire surface of the tergites, leaving only a narrow median band free. Sternites with light hairs and scales.

Distal margin of epandrium rounded. Cerci of usual shape, covered with hairs; sclerites only slightly chitinized. Epiphallus dorsally curved upward at distal extremity, forming a transverse trapezoidal comb. Cephalad to this comb is a stout rounded spine. Only the extreme tip of the phallus extends beyond the epiphallus. Ejaculator and apodemes small. Distal termination of gonocoxite rounded. Gonostyles stout, gradually narrowing towards apices (Figs. 13-16).

♀. Exactly like male except for broader frons.

Body length 8-10 mm, wings 8-9.5 mm.

Holotype: ♂, Georgia, Shiraksk steppe, El'dari, 4 August 1958 (V. Zaytsev).

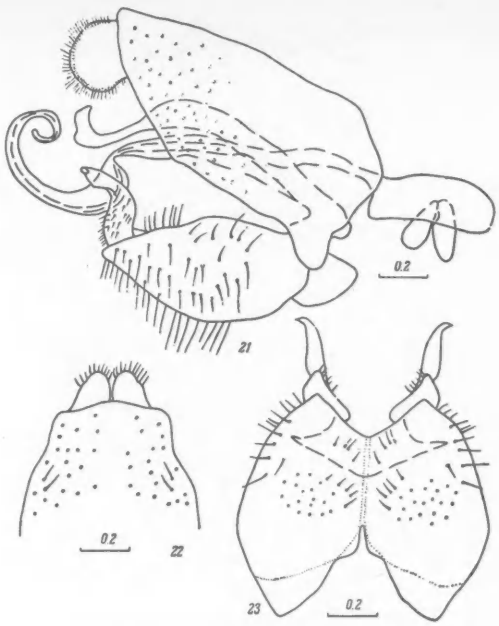
Allotype: ♀, Armenia, near Echmiadzin, 12 August 1925 (preserved in collection of the Institute of Zoology, Armenian Academy of Sciences, Yerevan).

Paratypes: 3 ♂, Azerbaydzhan, Kyurt-Makhmudly, Karyaginsk distr., 7 July 1940 (Trofimov).

Spongostylum punctipenne, sp. nov.

As regards structure of epiphallus and gonostyles this species is quite distinct from all other species of the isis group (Figs. 17-20). Typical external characters include a conspicuous group of black hairs on occiput caudad to ocellar tubercle, admixture of black hairs medially on upper margin of mouth and on coxae, and black scales on thorax and scutellum.

♂. Body grayish-black, mat. Frontal hairs black, facial hairs white except for a few coarse hairs medially on oral margin. Frons and face with white scales. Ocellar tubercle set back from compound eye at a distance almost equal to its width. First antennal segment dorsally with black, ventrally with white hairs. Third antennal segment bulbous, its slender apical part (without style) in ratio of 3:2 to the thick base; style a little more than half as long as slender apical part. Occiput covered with light hairs and scales. A large group of short, black hairs caudad to ocellar tubercle. Collar of white hairs. Surface of mesonotum and scutellum covered with erect black hairs and yellow scales, the latter becoming white on sides of mesonotum and posterior margin of scutellum. All thoracic and scutellar setae black. Pleura and coxae with white hairs and scales, except that there is always a considerable admixture of black, seta-like hairs on fore and mid coxae. Femora black, tibiae yellowish-alutaceous, leg setae black, scales light. Pulvilli as long as



Figs. 21 - 23 - Spongostylum rufulum, sp.nov. (mount 790).

claws. Costal hook yellow, base of costa with white scales. Wings hyaline; small alutaceous spots at base of radius and on rm, which lies rather near the middle of the discoidal cell. The r_{2+3} and r_4 veins invariably have adventitious spurs. Squama light, with white hairs. Halteres alutaceous to yellow with white knobs. Plumula white. Hairs on 1st tergite and sides of all other tergites white, with admixture of long white scales. Only on sides of 2nd tergite is there a small bundle of alutaceous hairs. Surface of tergites covered with long, black erect hairs situated nearer the posterior margins and with yellow and white scales. The latter are also present on the posterior margins of the tergites; the 5th and 7th tergites almost continuously covered with them, leaving free only a narrow median band. Sternites with white hairs and scales.

Epandrium large, its distal margin with small median protuberance. Cerci large, their lower and upper margins covered with coarser setaceous hairs. Sclerites narrow and long. Epiphallus dorsally bent upward at distal extremity to form a spine. Phallus extending well beyond epiphallus, terminally acuminate. Gonocoxite blunt at distal extremity. Gonostyle stout, rounded, with a digitiform outgrowth apically (Figs. 17-20).

♀. Exactly like male escept for wider frons and absence (?) of black setaceous hairs on coxae.

Body length 8-12 mm, wings 8-12 mm.

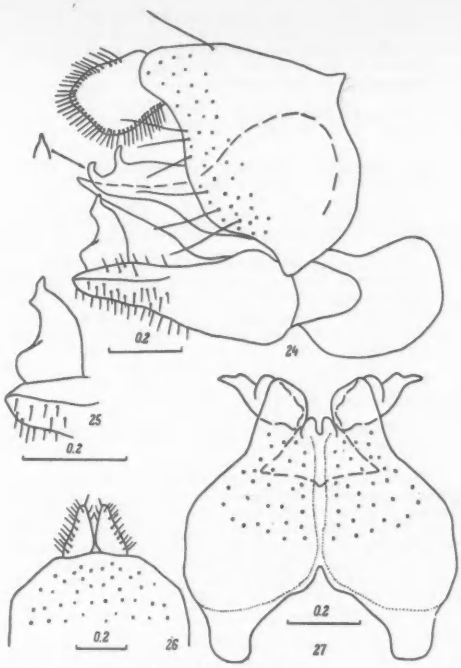
Holotype: ♂, Armenia, Karmir-Blur, nr. Yerevan, 23 June 1955 (V. Zaytsev).

Allotype: ♀, Georgia, Tbilisi, 19 July 1958 (V. Zaytsev).

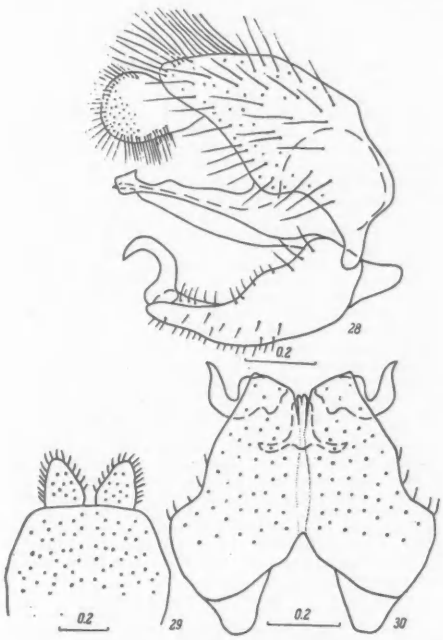
Paratypes: Armenia, 1 ♂, Asni, nr. Arazdayan st., 12 August 1959 (V. Zaytsev); 1 ♂, Vedi, sand, 26 May 1958 (V. Zaytsev); Azerbaydzhan: 1 ♂, Kyarki, 30 May 1958 (V. Zaytsev); Georgia: 1 ♂, Tbilisi, 9 August 1958 (V. Zaytsev).

Spongostylum rufulum sp. nov.

This species is distinguished by the peculiar, long,

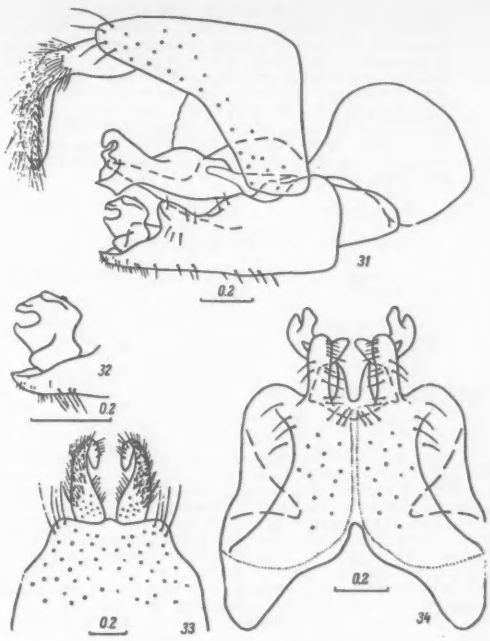


Figs. 24 - 27 - Spongostylum kozlovi Param. (mount 835).



Figs. 28 - 30 - Spongostylum montanum End. (mount 836).

strongly upcurved, terminally falcate phallus, which is very conspicuous even in dried specimens (Figs. 21-23). Typical external characters are the white hairs on fore and hind coxae, always with an admixture of black hairs on mid-coxae,



Figs. 31 - 34 - Spongostylum monticola Param. (mount 1022).

the predominance of black setae on the scutellum and the presence of dense, rusty yellow scales on the abdominal tergites.

♂. Body grayish-black, mat. Frontal hairs black, facial hairs yellow. Frontal and facial scales yellowish-white. Ocellar tubercle set at a distance, equal to its width, from the compound eyes. Antennae black, with black hairs dorsally and yellow hairs ventrally. Third antennal segment bulbous, its thickened base almost twice the length of the slender apical part (without style); style itself almost half as long as this apical part. Occiput with white hairs and scales. Mesonotal collar of white hairs. Mesonotum and scutellum covered with short, black hairs and rusty yellow and white scales. The latter become lighter in color on the sides of the mesonotum, where they form lighter-colored bands of hairlike scales; on the posterior scutellar margin these bands are pure white. In fresh specimens the mesonotal scales may be arranged in regular longitudinal rows. All thoracic and scutellar setae are black except on transalar calli and basally on sides of scutellum, where they may be yellow. Pleura with white and yellowish hairs and scales. Fore and hind coxae with light hairs and scales; always a few black hairs on mid coxae. Femora black, tibiae alutaceous to yellow. Hairs and setae on legs black, scales light. Pulvilli as long as claws. Costal hook yellow. Base of costa covered with yellow and white scales. Wings hyaline, alutaceous spots present only at base of radius and on rm, which is at the end of the basal third of the discoidal cell. Near the base of the r_{2+3} and r_4 there are invariably adventitious spurs. Squama white, with white hairs. Halteres yellowish alutaceous, apices of knobs white. Plumula white. Abdominal hairs white, forming conspicuous tufts on sides of first tergite. Surface of tergites covered with rusty-yellow scales. Posterior margins of tergites with pure white scales and fairly large, black setae. 5th and 6th tergites almost entirely covered with white scales, apart from a rather narrow band of rusty-colored scales medially. Sternites with white hairs and scales.

Eprandrium large, its distal margin lightly

curved. Cerci round, covered with simple hairs. Sclerites only slightly chitinized, digitiform. Epiphallus in the form of a large hook, entirely separate from phallus, with which it is only basally in contact; phallus very long, falcate in its distal half, with well developed apex. Ejaculator planoconvex, well apart from phallobase, with very small, poorly developed apodemes ventrally. Gonocoxite cyathiform, with sharp apex. Base of gonostyle dilated, the apical two-thirds strongly curved, first distally, then laterally (Figs. 21-23).

♀ not known.

Body length 9-10 mm, wings 8-9 mm.

Holotype: ♂, Armenia, Yerevan, 11 July 1956 (V. Zaytsev).

Paratypes: 3 ♂, Armenia, Yerevan, 11 July 1956 (V. Zaytsev).

Spongostylum kozlovi Param.

Paramonow, 1957: 130.

This species is distinguished from the other species of the kozlovi group known to us by the structure of the epiphallus and gonostyles. The distal extremity of the epiphallus is always upcurved in the form of a spine, with a second, round, long, spinelike process cephalad of this, also on the dorsal side. Base of gonostyle conspicuously dilated, its apex tapered and acuminate; conspicuous prominence always present on distal part near apex (Figs. 24-27). Typical external characters are the black pubescence of the whole body (white hairs present only on sides of 1st tergite), total absence of bands of white scales on abdomen, 4 radial cells in wing.

♂. Body black, shiny. Cephalic hairs and scales black, small admixture of yellowish-alutaceous scales present only on lower third of frons. Ocellar tubercle set at a distance equal to its width from margin of compound eyes. Antennae black, with black hairs. Third antennal segment bulbous, its wide base in the ratio of 3:2 to its slender apical part (without style), the style itself being only slightly more than half as long as the slender apical part. Occiput with short, black hairs, which become yellowish-alutaceous towards the center. Collar of black hairs, apart from a negligible admixture of white hairs. Mesonotum and scutellum with erect black hairs and sparse scales. Pleura and coxae with black hairs. Legs black, with black hairs, setae and scales. Pulvilli as long as claws. Costal hook black, base of costa with sparse black scales. Wings hyaline, only their base and anterior margin as far as r_1 alutaceous. Dark spots at base of radius, on vein rm which is situated at end of first third of discoidal cell, and at distal end of posterior basal cell. Squama light, with white hairs. Halteres darkly alutaceous, plumula black. First abdominal tergite with tuft of white hairs on its side; dense tufts of black hairs on sides of other tergites. Surface of tergites with short, sparse, erect, black hairs and very sparse, black scales. Sternites with black hairs and scales.

Distal margin of epandrium almost straight. Cerci round, covered with simple hairs except on lower margin, where there is a small group of coarser, setaceous hairs. Sclerites in the form of long, prolate plates. Epiphallus with its distal extremity dorsally bent upward, forming a spine, and with a large, cylindrical, spine-shaped process on its dorsal surface. Phallus terminally acuminate, extending conspicuously beyond epiphallus. Ejaculator very large, lateral apodemes small, medial apodeme well developed. Gonocoxite broad, round at distal extremity. Gonostyle basally dilated, apically narrowed, terminally acuminate; a conspicuous protuberance on distal part near apex (Figs. 24-27).

♀. Exactly like male except for broader frons.

Lengh of body and wings 8-10 mm.

Paramonow described this species from a series of specimens (4 ♂♂ and 5 ♀♀) from the Gobi. There are two specimens (♂ and ♀) in the collection of the Institute of Zoology, Academy of Sciences, USSR, mentioned as types by Paramonow. It seems best to take the male specimen as the holotype and the female as the allotype, regarding all the other specimens as paratypes.

Lectotype (holotype): ♂, Tszosto, Alashan Range, Gobi, 18 May 1908 (Kozlov).

Lectotype (allotype): ♀, Tszosto, Alashan Range, Gobi, 15 May 1908 (Kozlov).

Paratypes: 2 ♂ and 3 ♀, Tszosto, Alashan Range, Gobi, 14-18 May 1908 (Kozlov).

New material: Pamirs: 2 ♂♂ and 2 ♀♀ in cop., Balyandkiik River, Yangi-Davan estuary, 6 km NNW of Takhtakorum Pass, 4300 m, 3 August 1958 (K. Gorodkov); 2 ♀♀, S. Kaindy River, middle reaches of Balyandkiik River, 4000 m, 14 August 1958 (K. Gorodkov).

Spongostylum montanum End. (♂ nov.).

Enderlein, 1934: 141 (Coniomastix montana End.); Paramonow, 1957: 131-132.

The species was described by Enderlein from the southern Pamirs as the type of a new genus Coniomastix. The description is very brief, but even so, enabled Paramonow to place this species as a member of the genus Spongostylum or Anthrax. Paramonow (1957) places it in the kozlovi group of Spongostylum. This is probably correct. We have eight specimens from the Pamirs which, according to the description, belong to the species, including 5 males.

The male hypopygial structure also bears out the correctness of placing montanum in Spongostyla. The epiphallus has a small triangular spine dorsally near the distal extremity and a round protuberance cephalad to this. The gonostyles are long and uncinate (Figs. 28-30). Spongostylum montanum is characterized by having the wing with four radial cells, the frons with a large number of white scales, the upper part of mesopleuron with a tuft of white hairs, the squama white with white hairs and the abdominal tergites with bands of white scales.

♂. Body black, shiny. Hairs on head and antennae black, scales black, yellowish and white. Ocellar tubercle set at a distance from the compound eye equal to half its own width. Antennae black; 3rd segment pyriform, with a very short style. Collar of black hairs, with considerable admixture of white on mesonotum. Surface of mesonotum and scutellum covered with erect black hairs. Bands of long white scales on sides of mesonotum cephalad to wing base. Mesopleuron above with a tuft of dense white hairs. Remaining parts of pleura and coxae with black hairs. All setae on thorax and scutellum black. Legs black, with black hairs and black and light scales. Costal hook darkly alutaceous, base of costa with infuscate scales. Wings hyaline except for anterior margin as far as r_1 and wing base, which are alutaceous. At base of radius, on rm, which is rather near the middle of the discoidal cell, and on distal extremity of posterobasal cell, there are alutaceous spots. Adventitious spur invariably present on r_{2+3}. Squama white, with white hairs. Halteres alutaceous-black, plumula black. Sides of 1st tergite with tufts of white hairs. Sides and dorsum of remaining tergites with black hairs and scales. Narrow bands of pure white, shining scales on posterior margin of 2nd and 3rd tergites. Large patches of similar scales on sides of 6th and 7th tergites, covering the greater part of them; 5th-7th tergites curved rooflike. Sternites with black hairs and scales.

Epandrium with an almost straight distal margin. Cerci round, with coarser hairs on underside. Sclerites rod-shaped. A round tubercle dorsally on epiphallus, slightly beyond the center, and a sharp triangular comb terminally. Phallus appressed to epiphallus only its very extremity protruding slightly beyond. Gonocoxite broad, flat, round at distal extremity. Gonostyles long, uncinate and sharp (Figs. 28-30).

♀. Exactly like male except for broader frons.

Body length 6.5-9 mm, wings 7-10 mm.

Allotype: ♂ in cop., Pamirs, Murgab valley, Chottukay landmark, 3 km below W. Pshart estuary, 3325 m, rock-debris semi-desert, 29 June 1958 (K. Gorodkov).

Paratypes: Pamirs: 1 ♂, middle reaches of E. Pshart, 3600 m, osier bed, 25 June 1958 (K. Gorodkov); 2 ♂♂, Murgab valley, Chottukay landmark, 3 km south of W. Pshart estuary, 3325 m, rock-debris semi-desert, 29 June 1958 (K. Gorodkov).

New material: Pamirs: 1 ♀ in cop., Murgab valley, Chottukay landmark, 3 km below W. Pshart estuary, 3325 m, rock-debris semi-desert, 29 June 1958 (K. Gorodkov); ♀, S. Takhtakorum gorge, Takhtakorum valley, 3700 m, gravel, 30 July 1958 (K. Gorodkov); 1 ♂, 1 ♀ in cop., middle reaches of E. Pshart, 3600 m, osier bed, 25 June 1958 (K. Gorodkov).

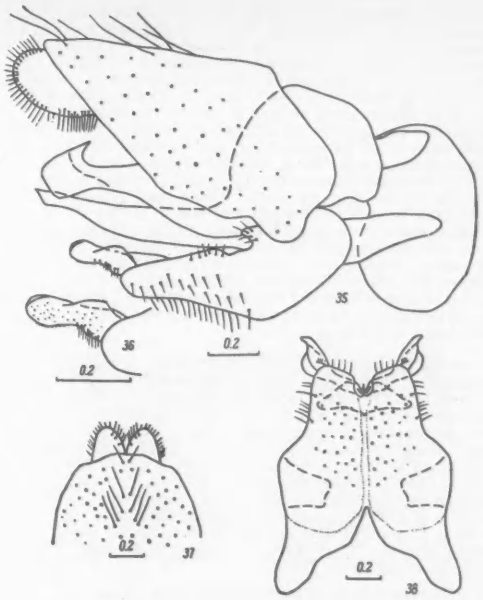
Spongostylum monticola Param. (♂ nov.).

Paramonow, 1957: 134.

This species belongs to the kozlovi group. It is clearly distinguished from other species of this group as regards hypopygial structure by the uncinate cerci, broad, poorly sclerotized epiphallus and structurally complicated gonostyles with numerous outgrowths (Figs. 31-34). The following external characters are typical: thoracic pubescence black except for the invariable presence of a large number of white hairs on pleura, completely transparent wing base except for a few dark patches, white squama with white hairs, and white plumula.

♂. Body black and slightly shiny. Cephalic hairs black, scales white and black. Ocellar tubercle set at a distance from compound eye almost equal to its own width. Antennae black, with black hairs. Third antennal segment bulbous, its wide base in the ratio 4:5 to the slender apical part (without style); style itself little more than half as long as the apical part. Occiput with greenish-gray pollen, covered with black and alutaceous hairs and light scales. Mesonotal collar of white hairs with considerable admixture of black, but black hairs alone on lower half of thorax. Mesonotum and scutellum covered with erect black hairs and light scales. All setae on thorax and scutellum black. Pleura covered with black hairs mixed with white. A particularly thick tuft of white hairs on upper part of mesopleuron. Coxae also with black and white hairs. Legs black, with black hairs and setae and with black and light scales. Pulvilli two thirds as long as claws. Costal hook alutaceous, base of costa with dark scales. Wings hyaline except for an area between sc and r_1, which is lightly alutaceous. Alutaceous patches on base of radius, on rm, which is situated at the end of the basal third of the discoidal cell and on distal extremity of posterobasal cell. Adventitious spurs invariably present on r_{2+3} and r_4. Squama white, with white hairs. Plumula white. Halteres alutaceous, apices of knobs white. Dense tufts of white hairs on sides of 1st tergite; sides of remaining tergites, as well as their dorsal surface, with black hairs only. Scales on tergites black and yellow. A narrow band of pure white, shining scales on posterior margins of 1st, 2nd and 3rd tergites. Large patches of similar scales, occupying the greater part of the tergite, on sides of 6th and 7th tergites. The latter are curved rooflike. Sternites with black hairs and scales.

Distal margin of epandrium almost straight, with a slight median protuberance. Cerci narrow, long, uncinate, thickly covered with coarse setae. Sclerites in the form of prolate plates. Epiphallus very broad, closely embracing apex of phallus; a few rounded processes on distal extremity of epiphallus. Ejaculator and lateral apodemes small, median apodeme large. Gonocoxite greatly dilated near the middle, where in lateral view, its margin forms a right angle and its distal part is in the form of a rounded extension. Gonostyle small, with complex branching, and a rounded lateral tubercle at the extreme base. Distal surfaces of gonostyles bear a pair of fairly long, acuminate processes, the upper of which is deflexed distally; topmost margin of gonostyle strongly deflexed laterally, bent almost at a right angle (Figs. 31-34).



Figs. 35 - 38 - Spongostylum pamirense Param. (mount 1021).

♀ exactly like male except for broader frons and better-developed white pubescence on thorax.

Length of body and wings 8-10 mm.

Holotype: ♀, Peter I Range, Kara-Shura valley, Gursy-Tau River, 29 July 1911 (Gol'bek).

Allotype: ♂, Pamirs, middle course of W. Pshart, 5 km above Dzhan-Kaindy estuary, 3600 m, 11 July 1958 (K. Gorodkov).

New material: Pamirs, 1 ♀, Murgab valley, Chottukay landmark, 3 km below. W. Pshart estuary, 3325 m, 29 June 1958 (K. Gorodkov); 1 ♀, middle reaches of E. Pshart, 3600 m, osier bed, 25 June 1958 (K. Gorodkov).

Spongostylum pamirense Param. (♂ nov.).

Paramonow, 1957: 134-135.

This species belongs to the kozlovi group. In hypopygial structure the male is readily distinguished from other species of this group. The epiphallus is greatly dilated terminally, with a large sharp tooth on the dorsal side. The gonostyles are prolate, rod-shaped, each with a large, round, lateral comb near the middle (Figs. 35-38). In external morphological characters it is nearest to S. monticola Param., from which it differs in having a shining occiput, black hairs on posterior margin of squama and a completely black thoracic pubescence (white hairs admixed with the black only in the upper part of the collar).

♂. Body black, shiny. Hairs on head and antennae black, scales dark, with slight admixture of light scales below on frons. Ocellar tubercle set at a distance equal to half its width from the compound eye. Third antennal segment bulbous, its broad base in the ratio of 4:5 to the slender apical part (without style), style itself little more than half as long as apical part. Occiput covered with short, black and alutaceous hairs. Collar of black hairs, with admixture of white on upper half of mesonotum.

All other pubescence and setae on thorax, scutellum and legs black. Legs black, with black and darkly alutaceous scales. Pulvilli as long as claws. Costal hook black. Base of costa with black scales. Wings hyaline, with only the anterior margin as far as r_1 and the wing-base itself alutaceous. In addition, there are large dark patches at base of radius, in the rm region (the rm itself being situated at the end of the basal third of the discoidal cell), and on distal margin of posterobasal cell, which is itself slightly infuscate. Adventitious spurs present on r_{2+3} and r_4. Squama brownish-black, plumula black. Dense tufts of pure white hairs on sides of 1st tergite; tufts of black hairs on sides of the other tergites. Surface of tergites with black hairs and scales. Small bands of pure white, shining scales on posterior margin of sides of 2nd and 3rd tergites. Larger patches of similar scales on sides of 6th and 7th tergites, which are conspicuously curved rooflike. Sternites with black hairs and scales.

Distal termination of epandrium round. Cerci of usual shape, with a very slight admixture of seta-like hairs on lower margin. Sclerites rod-shaped. Distal extremity of epiphallus with broad pads on ventral side, embracing the apex of the phallus, and with a large, sharp spine on the dorsal side. Phallus obliquely truncate terminally. Ejaculator very strongly developed, with large apodemes. Distal extremity of gonocoxites obliquely truncate, blunt. Gonostyle in the form of a thick, round rod, slender apically, strongly curved laterally and with a large comb, also running laterally. Surface of gonostyles with small, not dense striae (Fig. 35-38).

♀ Exactly like male except for broader frons and slightly greater development of light scales on frons; 6th and 7th tergites of usual shape.

Body length 8-10 mm, wings 8.5-10.5 mm.

Holotype: ♀, Pamirs, Sary-Kol Range, 4300 m, 13 July 1928 (Reykhardt).

Allotype: ♂, Pamirs, Gorno-Balakhshan Autonomous Province, 15 km NW of extremity of Fedchenko Glacier, Kaindy River, 3600 m, 17 August 1958 (K. Gorodkov).

New material: 1 ♀, Balyandkiik River, 6 km N. Takhtakorum Pass, 4300 m, gravel, 3 August 1958 (K. Gorodkov); 1 ♀, upper reaches of W. Pshart, Kilil-Istyk estuary, 4100 m, cushion plants on terrace, 17 July 1958 (K. Gorodkov).

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AFFINITIES WITHIN THE FAMILY CHAMAEMYIIDAE (DIPTERA)

V. N. TANASIYCHUK

In recent years there has been a marked increase in the number of papers on Chamaemyiidae (Diptera). The reason is that many larvae of Chamaemyiidae are effective predators on aphids and coccids, and are therefore of great interest for biological control purposes. Nearly all these new papers, however, deal only with individual species, describing and redescribing them, explaining their biology, effectiveness and so forth. Even experienced entomologists are still describing new species and genera without examining the genitalia, although it was as long ago as 1938 that Hennig pointed to study of the copulatory apparatus as the only way to clarity in Chamaemyiidae systematics.

At present the Chamaemyiidae family consists of a haphazard collection of various taxonomic groups whose affinities one with another are unknown. It is hopelessly difficult to define many of the older species, particularly those belonging to the extensive genus Leucopis. The only available key (Czerny, 1936) is of limited value, since it does not consider genital characters. Nowhere is there a summary of the new species, most of which have been described within the last 10-15 years, despite the great practical demand for such information.

We are convinced that it would be unrealistic to revise the family Chamaemyiidae and compile full keys until the primary distinguishing features of this natural system have been discovered. Hennig (1958) has given the clue to solving this problem: he believes that study of the copulatory apparatus of Diptera Schizophora males, with its complicated structure, can throw light on many obscure problems of affinities.

In the present paper we shall attempt to develop this idea in regard to the Chamaemyiidae.

The material used was the collections of Chaemaemyiidae from the European part of the USSR preserved in the Institute of Zoology, Academy of Sciences, USSR. The number of species treated (by genera) were: Acrometopia—1, Parochthiphila—2, Chamaemyia—5, Leucopis (Neoleucopis)—1, Leucopis (Leucopomyia)—2, and Leucopis s. str. —10.[1]

As regards each of the Leucopis species, all available material was studied. The genera Acrometopia, Parochthiphila and Chamaemyia were selectively investigated. The procedure was as follows.

1) Mounts of the male genitalia were prepared. After maceration in 20% potassium hydroxide and washing, the hypopygium was passed through alcohol, toluol and oil; then the genitalia proper were dissected with very fine dissecting needles and transferred to balsam. The mounts were set on small pieces of cover glass (5 x 10 mm) with thick paper glued underneath; 4 x 4 mm pieces of glass were used as covers. These mounts were pinned on the same pin as the insect, a procedure which greatly simplifies the work.[2] The examination of the genitalia was performed on fresh mounts which had not yet hardened. This was a practical possibility for one and a half to two months after preparation. The method proved much more convenient than examination in oil, for it meant that the genitalia were permanently in the position most convenient for examination and drawing—an impossibility in working with oil. The genitalia were examined and drawn mount by mount.

In the course of the work it was found that the most convenient position, giving all the genital peculiarities and variations, was foreshortened profile, when the extremity of the left gonocoxite is clearly projected on to that of the right, the left-hand side of the sternite coincides with the right and so forth. Hardly anything was gained by examining the genitalia from above and below. Some details of the gonocoxite structure stood out when the specimen was viewed from the rear. To draw the extremities of the gonocoxites it was necessary to alter the position of the mount so that the plane of the gonocoxite was as nearly as possible perpendicular to the optical axis of the microscope.

Altogether, some 800 mounts of Chamaemyiidae genitalia were prepared. For certain very numerous species more than 100 mounts were treated.

2) The external morphology of the imagos was compared, with particular attention to the chetotaxy of head and pronotum and to the pigmentation of pronotum, abdomen and legs. Drawings and photographs were made.

3) In the course of the work the morphology of the larval stages as well as the biology of larva and imago were taken into account.

As a result of examining the structure of the genitalia and the external morphology of the imago it was found that the material treated could be divided into nine groups of species which were closely related beyond all doubt. Some of these groups coincide with modern taxonomic units, others do not.

Before we pass on to a review of these groups we shall give a brief account of the genital structure of Chamaemyiidae.

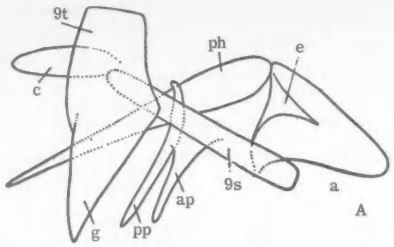
Figure 1 is a sketch of the usual genitalia in Leucopis species.[3] The genitalia of the other genera can be compared with this sketch.

The central detail of the genitalia is the 9th sternite, to which all the other structural units are attached. This is a sclerotized ring of very variable shape; the cerci are attached to this posteriorly, the phallic apodeme anteriorly and above; within the ring the anterior and posterior parameres run off from it; in a number of cases they are partially or completely joined to the sternite. The 9th tergite is connected to the sternite by an articulated prominence. In some groups the 9th tergite is rounded on the inner margin, in others it turns into an elongated process which we identify with the gonocoxite. The phallus, which is suspended on membranes, passes freely through the ring of the 9th sternite.

[1] Excluding 10 new Leucopis species described by us (awaiting publication).

[2] Method communicated to us by I. A. Rubtsov.

[3] Key to Figs. 1-10: a—phallic apodeme, e—excision of apodeme, g—gonocoxite, ocs—ocellar setae, dcs—dorsocentral setae, pp—posterior paramere, ap—anterior paramere, ors—orbital setae, prs—prescutellar setae, ph—phallus, c—cerci, 9s—9th sternite, 9t—9th tergite.



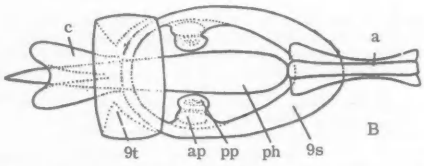


Fig. 1 - Structure of male genitalia in Leucopis. A - profile; B - viewed from above.

An apodeme is attached to its basal part, often with conspicuous sharp excision.

The Group ACROMETOPIA

The group coincides with the genus Acrometopia Schin. We selected one species for examination—A. wahlbergi. Zett.

The basic character of the genus is the very prolate head (Fig. 2, F); the horizontal frons and canted facial part form an acute angle.

On the head are two pairs of orbital setae, a pair of fairly long ocellar, a pair of postvertical and two pairs of vertical (outer and inner, respectively), setae (Fig. 2, E). On the mesonotum there are four pairs of large dorsocentral and a pair of prescutellar setae (Fig. 2, D).

Genitalia ♂ (Fig. 2, A-C). The round, strongly convex 9th tergite is covered with chaetae. In profile, the sternite is triangular. The posterior parameres are fairly clearly differentiated; the anterior parameres are reduced, all that is left of them being a tubercle covered with chaetae (Fig. 2, B, C). The phallus (Fig. 2, B) is of complex shape, the phallic apodeme greatly elongated and constricted.

As regards both genital structure and external morphological characters Acrometopia is undoubtedly a group which diverges a great deal from the general structural plan of Chamaemyiidae. In shape of head and certain structural details of the genitalia it resembles none of the groups we shall discuss below. A rather similar shape of sternite, with reduced anterior parameres, occurs in the Leucopis group vorax, but the convergence is probably only superficial. By stretching a point, we can speak of some affinity between Acrometopia and groups (genera) of Chamaemyia, especially Parochthiphila, to which it is fairly similar as regards the chaetotaxy of mesonotum and head.

The biology of Acrometopia is unknown.

The Group PAROCHTHIPHILA

This group includes the genus of the same name. We investigated two species, P. coronata Loew (Fig. 3) and P. nigripes Str. The principal character of this genus is its comparatively round, anteriorly nonacuminate head and the presence of four pairs of dorsocentral setae.

The head (Fig. 3, D, E) bears two pairs of orbital, one pair of ocular and one pair of postvertical setae. The mesonotum (Fig. 3, C) bears four pairs of dorsocentral setae; prescutellar setae are lacking.

Genitalia ♂ (Fig. 3, A, B). 9th tergite similar to that of Acrometopia, but slightly more elongate. Posterior parameres with acuminate, not curved extremities clearly separated from 9th sternite; anterior parameres fairly distinctly developed, although joined to sternite. Apodeme more compact than in Acrometopia.

In P. nigripes the basal part of the phallus is somewhat differently sahped and the apodeme is more pronounced; in general, however, these differences are unimportant.

The Parochthiphila group is distinct and compact; the species are well defined both as regards external morphological characters and as regards structure of the genitalia. It is only distantly similar to Acrometopia and approaches another, equally distinct group, the Chamaemyia group, from which it differs in the pronotal chaetotaxy and some very minor structural details of the genitalia (in Chamaemyia the acuminate apices of the posterior parameres are curved, in Parochthiphila they are not).

The biology of the most of the species is unknown. In 1960 Ye. S. Sugonyayev, at Manaskent (Dagestan, Caspian coast), captured in reed, one female of a Parochthiphila species, predaceous on the mealy bug Chaetococcus phragmitis March., which has not yet been described.

The Group CHAMAEMYIA

This group includes the genus of the same name. We investigated five species: Ch. elegans Panz., Ch. polystigma Meig., Ch. juncorum Fall., Chamaemyia sp. aff. flavicornis Str. and Chamaemyia sp. aff. flavipalpis Hal.

Drawings of Ch. juncorum are shown in Figure 4.

The principal character of the genus is the presence of three pairs of dorsocentral and one pair of prescutellar setae on the mesonotum (Fig. 4, C). The chaetotaxy of the head (Fig. 4, D, E) is the same as in Parochthiphila.

Genitalia ♂ (Fig. 4, A, B) very much the same as in Parochthiphila. The only distinct difference is in the shape of the posterior parameres, their extremities being always curved downwards. Both pairs are more clearly separated from the sternite. The structural plan of the remaining details—tergite, phallus, apodeme—is no different from that of Parochthiphila.

The interspecific differences in Chamaemyia are usually quite distinct; the species are well defined as regards both external morphological characters and genital structure, the most variable details of the genitalia being the 9th tergite, the phallus and its apodeme and the anterior parameres.

As already mentioned, the group is very similar to Parochthiphila but there is always a clear distinction in both external morphology and structure of the genitalia.

The biology is unknown. Chamaemyia species are closely associated with herbaceous vegetation.

The Group LEUCOPOMYIA

This group coincides with the subgenus Leucopomyia Mall. of the genus Leucopis Meig. s. l.

We investigated two species—L. silesiaca Egg. and L. alticeps Czerny.

The principal character of the group is the absence of orbital and ocellar setae from the head (Fig. 5, C, D), and the presence of a pair of prescutellar setae on the mesonotum (Fig. 5, C).

Genitalia ♂ (Fig. 5, A) are in general strongly reminiscent of Chamaemyia genitalia despite considerable variation in all details. The 9th tergite is like that of Chamaemyia, greatly elongated vertically. The triangular (in profile) 9th sternite is also suggestive of Chamaemyia, as are the posterior parameres. The anterior parameres are very different: they taper and look like transparent sclerotized bracts. The phallus and its apodeme resemble the corresponding sclerites in Chamaemyia but the base of the phallus is more rounded, while the apodeme is larger.

The Leucopomyia group is obviously very similar to the

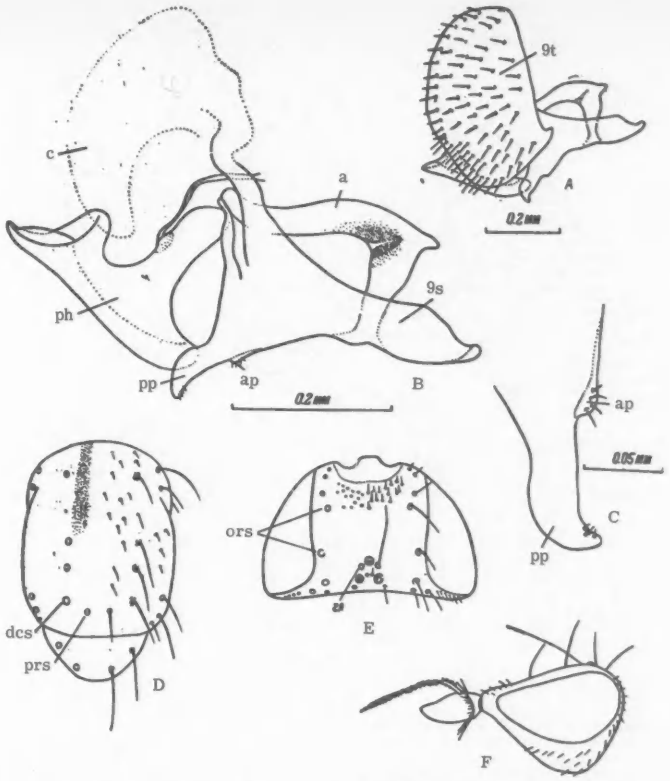


Fig. 2 - Acrometopia wahlbergi Zett. A - ♂ genitalia; B - the same without 9th tergite; C - extremity of posterior and rudiment of anterior parameres; D - mesonotum; E - head, from above; F - head in profile.

Chamaemyia group, and to that group rather than to Parochthiphila, as can be seen from the presence of prescutellar setae and the curved apices of the posterior parameres.

Leucopomyia larvae are predaceous on coccids. Their biology has been fairly thoroughly studied.

The Group NEOLEUCOPIS

This group includes the subgenus Neoleucopis Mall. of the genus Leucopis Meig. s. l. Only one specimen of this genus has been found in the Institute's collections, identified by A. A. Shtakel'berg as Neoleucopis sp. aff. atratula Ratz. According to Czerny (1936) only the species atratula has been noted in the Palaearctic region.

The principal character of the group is the presence of ocellar setae on the head and the absence of orbital setae (Fig. 6, C, D). There are two pairs of prescutellar setae on the mesonotum (Fig. 6, B).

Genitalia ♂ (Fig. 6, A). Large 9th tergite with a clavate gonocoxite deriving from it. 9th sternite very elongate, its posterior extremity tapering and curving upwards. Parameres short and thick; phallus also much shortened, its apodeme fairly large.

The group nearest to this seems to be Chamemyia (apart from the glyphinivora group, described below), which it resembles in that the ocellar and prescutellar setae are still not reduced. As regards the structure of the genitalia, however, this group differs greatly from Chamaemyia.

Subgenus Leucopis s. str.

The species included in the subgenus Leucopis, sensu stricto, are characterized by the absence of orbital, ocellar and prescutellar setae (Fig. 7, B-D). We distinguish four groups of species, not differing in external morphology but clearly distinguishable in the structure of the genitalia.

The Group GLYPHINIVORA

This group is the richest in species and includes Leucopis glyphinivora Tanas., L. melanopus Tanas., L. atritarsus Tanas., L. rufithorax Tanas, L. grandis Tanas. We also include in this group seven species of which descriptions have not yet been published.

In external morphology the species are indistinguishable from other representatives of the subgenus Leucopis s. str. They differ from other groups only in the structure of the genitalia. All the differences in this respect can be reduced to a single type, the "purest" expression of which is probably to be found in the genitalia of L. glyphinivora Tanas. (Fig. 7, A).

The 9th tergite is fairly broad, medially dilated. It bears a more or less elongate and clavate gonocoxite, (very long and narrow in profile but broad and clavate in rear view). The 9th sternite is usually broadened near the middle. Anterior parameres much widened basally; the elongated posterior parameres often sabre-shaped. The phallus varies greatly.

In a number of species the interspecific differences are inconspicuous even as regards genital structure, while to identify some of them from the external morphology of the imago is exceedingly difficult or even impossible. Familiarity with the larval biology and morphology is a great

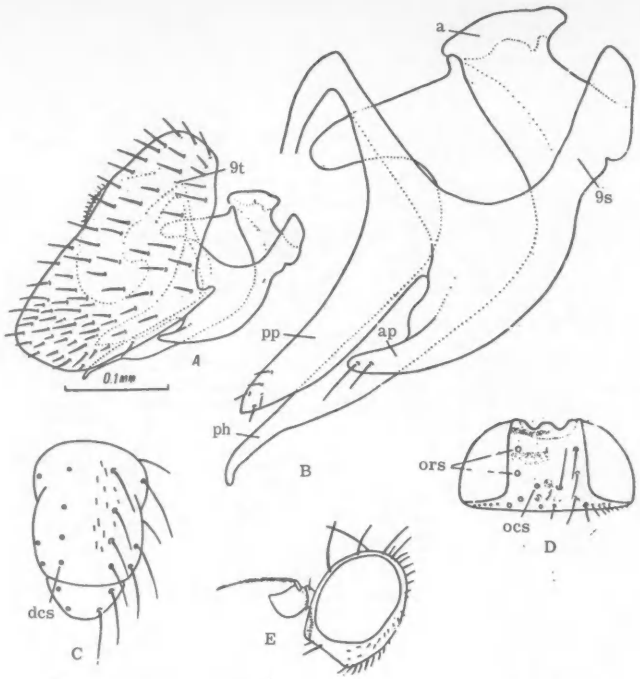


Fig. 3 - Parochthiphila coronata Loew. A and B as in Fig. 2; C - mesonotum; D - head, from above; E - head in profile.

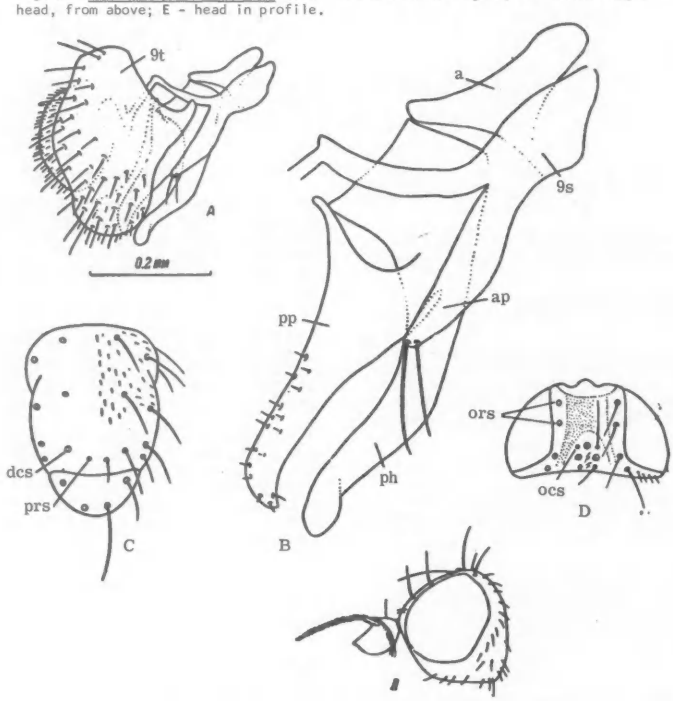


Fig. 4 - Chamaemyia juncorum Fall. Legend as in Fig. 3.

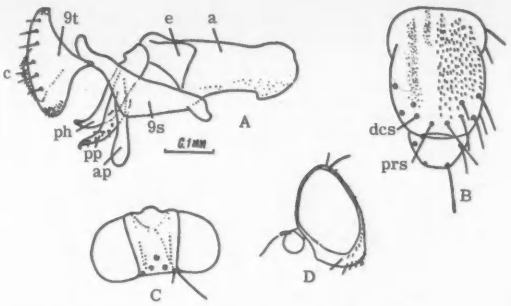


Fig. 5 - Leucopomyia silesiaca Egg. A - ♂ genitalia; B - mesonotum; C - head, from above; D - head in profile.

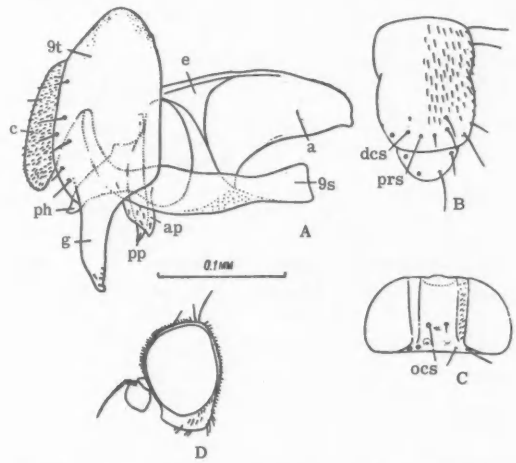


Fig. 6 - Neoleucopis sp. aff. atratula Ratz. Legend as in Fig. 5.

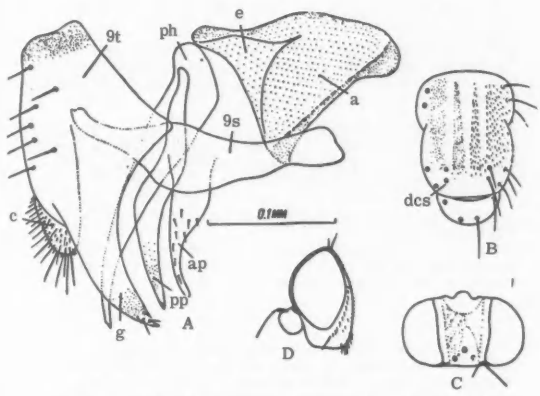


Fig. 7 - Leucopis glyphinivora Tanas. (subsp. taurica Tanas.) A,B,C as in Fig. 5; D - head, lateral view.

help in this respect.

Intraspecific variation is considerable. In different places the populations vary as regards intensity of pigmentation on the pronotal bands and coloration of legs and abdomen. These differences often accompany considerable differences in the structure of individual components of the genitalia. The most constant feature is the shape of the phallus, which

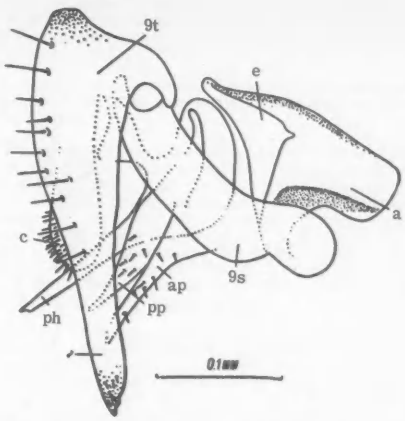


Fig. 8 - Leucopis fumidilarva Tanas, ♂ genitalia.

is therefore one of the basic diagnostic characters in this group.

As regards the general structural arrangement of the genitalia the species of this group most closely resemble Neoleucopis; the two groups are without doubt closely related.

The larvae of all species whose biology has been discovered are predaceous on ectophytic aphids.

The Group FUMIDILARVA

This group includes the species Leucopis fumidilarva Tanas. and one species, the description of which has not yet been published. There are no differences in the external imaginal morphology; the group is distinguished by the structure of the genitalia and the larval morphology.

Genitalia ♂ (Fig. 8). The 9th tergite is vertically prolate, with an articulated prominence on its upper margin. The 9th sternite is fairly broad throughout its length. Phallus dilated near the base, posterior parameres medially dilated.

The larval chaetotaxy is characterized by a peculiar arrangement of the setae, which appear on all parts of the body in small groups with irregular but distinct boundaries. Species of the group fumidilarva cannot be identified from the external appearance of the imago, since in this respect they are indistinguishable from certain species of glyphinivora. Identification from the male genitalia and larval morphology, however, is reliable. Intraspecific differences in the structure of the genitalia are slight.

In the shape of the 9th tergite and sternite this group resembles only Leucopomyia. The larvae of both species of the fumidilarva group are predaceous on ectophytic species of aphids.

The Group PALUMBII

We include two species in this group: Leucopis palumbii Rond. and L. magnicornis Loew.

The group cannot be diagnosed from external characters but only from the structure of the male genitalia (Fig. 9).

In the species of this group the 9th tergite is greatly constricted and vertically prolate. The gonocoxite is slightly narrower than the tergite and, as a rule, apically rounded. The articulated process on the tergite is situated slightly above its center. The 9th sternite has a characteristic, triangular shape. Parameres well developed; shape of phallus variable, widest at the very base in L. palumbii but nearer the middle in L. magnicornis.

Intraspecific variations, whether in the external

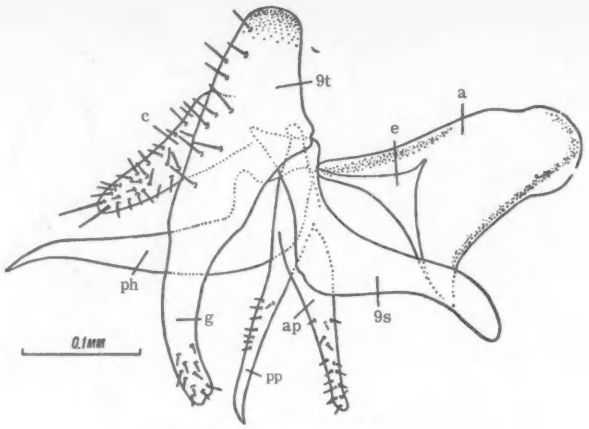


Fig. 9 - Leucopis palumbii Rond., ♂ genitalia.

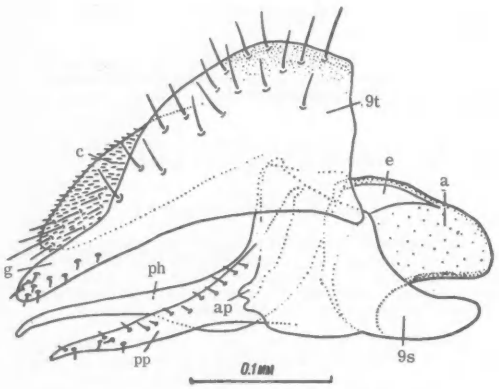


Fig. 10 - Leucopis vorax Belan, ♂ genitalia.

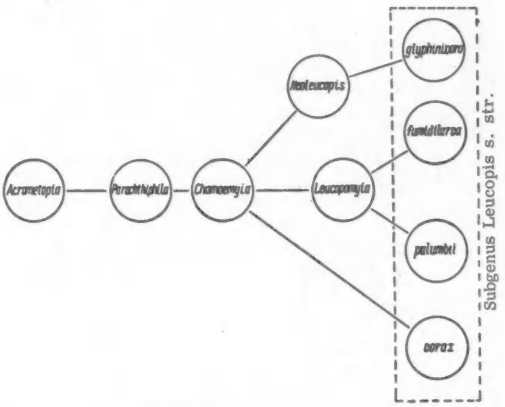


Fig. 11 - Group affinities of Chamaemyliidae family.

appearance of the imago or the structure of the genitalia, are slight. The interspecific differences are very distinct in both respects.

As regards similarity in the shape of the 9th tergite and sternite the group appears closest to the Leucopomyia group.

The biology of one species, L. palumbii Rond., is known. The larvae of this species are predaceous on aphids in pistachio galls.

The Group VORAX

This group includes two species, Leucopis vorax Belan. and L. argenticollis Zett. It cannot be diagnosed from the external morphology of the imago but only from the consistent structure of the genitalia.

The principal character of the group is the peculiar, almost triangular form of the 9th sternite and the reduction of the anterior parameres (Fig. 10); on the posterior margin of the sternite these are replaced by several teeth.

In L. argenticollis and L. vorax the 9th tergite is strongly differentiated; there is also a difference in the shape of the phallus and posterior parameres.

Intraspecific variations in external morphology and genitalia are slight. The species are easily identified.

In the structure of the sternite the group resembles only Chamaemyia species. A further resemblance to that group is the presence of paired spots on the abdomen, not only on the 3rd but also on the 4th and 5th segments; this character does not occur in any other Leucopis species but is almost invariably present in Chamaemyia.

The biology of vorax species varies L. vorax larvae are predaceous on the ovisacs of Eriopeltis lichtensteini Sign., those of L. argenticollis feed on the aphid Hyaloperus arundinis F. on reed grass.

The differences in biology, as well as in a number of structural details of the genitalia, indicate that this may be an artificial group and that each species in reality belongs to a different group. The problem may be cleared up as new material becomes available.

We have considered nine groups of Chamaemyiidae. There are undoubtedly a great many more, for the material we examined was very limited both geographically and quantitatively. We nevertheless think the available data adequate as a basis for certain conclusions.

We attempted to arrange the nine groups in order of affinity. A number of them could be classified in terms of the reduction of certain large setae (the orbital and ocellar on the head, the dorsocentral and prescutellar on the mesonotum). Examining this initial arrangement, we found that along with the reduction of the setae there were definite trends in modification of the genitalia: vertical elongation of the 9th tergite, individualization of the gonocoxites, tapering of the 9th sternite and posterior parameres,

increasing diversification in the shape of the phallus. This made it possible to include in the scheme groups belonging to the subgenus Leucopis s. str., which formed a single large group as regard external morphology but differed in structure of the genitalia. The fact that there is a correlation in the direction of modification of the genital structure and of the external morphology seems to us a sure indication that the system of classification we have produced does in some measure reflect the actual affinities within the family Chamaemyiidae.

Let us examine this system (Fig. 11). The Parochthiphila group, which possesses the greatest number of dorsocentral setae and a type of genital structure from which all the other forms can be derived, can evidently be regarded as the "nucleus" or main link of the whole family.

To one side of this group we have Acrometopia, which has the same number of setae on head and mesonotum, if not more. This group differs sharply from the general plan of Chamaemyiidae structure both in external appearance (shape of head) and in structure of the genitalia (reduction of anterior parameres, unusual shape of phallus).

On the other side is Chamaemyia, which has one pair of dorsocentral setae fewer than Parochthiphila. The genitalia are almost unchanged.

From Chamaemyia run three branches.

The first is represented by Neoleucopis and its continuation, glyphinivora. The transition from Chamaemyia to Neoleucopis is abrupt: some of the head and mesonotal setae are reduced and the type of genital structure is strongly modified. The transition from Neoleucopis to glyphinivora is more gradual: the ocellar and prescutellar setae disappear and the structure of the genitalia is only slightly different.

A second branch leads to the group Leucopomyia and groups related to it. As in the previous case, there is a sharp reduction of setae; Leucopomyia retains the prescutellar setae, and the genitalia are still largely suggestive of Chamaemyia genitalia. The next stage is from Leucopomyia to palumbii and fumidilarva. These two are not connected with each other, but in both the prescutellar setae are already lacking and the genitalia differ a good deal from those of Chamaemyia.

The third branch consists of the group vorax, which resembles only Chamaemyia. No intermediate stages were detected. The group vorax has lost the orbital, ocellar and some of the prescutellar setae but still resembles Chamaemyia in a number of details of genital structure.

We see, then, that four groups enter into the subgenus Leucopis s. str. These are similar to various groups of other subgenera and even of another genus but are not directly related to one another. The characters in virtue of which the species forming these groups have been brought together into a single subgenus (similarity of external morphology and the sometimes almost identical arrangement of setae on head and mesonotum) seem to be the result of a convergence in the very remote past.

Our scheme cannot be regarded as a phylogenetic pattern but reflects only the morphological similarities of the forms in question.

Certain phylogenetic inferences are nevertheless possible. It seems that the most "stable" groups, which have been longest established, are those in which there are clearcut interspecific differences and negligible intraspecific variations—Parochthiphila, Chamaemyia, Leucopomyia and, of course, Acrometopia. Conversely, glyphinivora, consisting of a large number of species differing little from one another but with wide intraspecific variations, is undoubtedly the youngest group from the phylogenetic point of view and may still be in statu nascendi.

The diversity within the genus Leucopis, and particularly in the subgenus Leucopis s. str., makes its detailed revision a present necessity. It will probably be necessary to increase the number of modern Leucopomyia and Neoleucopis subgenera, to convert certain Leucopis s. str. groups into subgenera and to make the vorax group an independent unit of some kind.

On the other hand, we think it would be premature to undertake such a revision for the moment, in view of the very incomplete state of the data. Chamaemyiidae systematics, particularly in regard to the genus Leucopis, are already in a very muddled condition. Synonyms are numerous; so too are the categories—not merely the unavoidable specific taxonomic divisions, but also the higher ones. There is no point in further multiplying the number of synonyms. The first essential is to get a rough outline of the whole family, starting with a list of all species of Chamaemyiidae; for this purpose, study (drawing and description) of the genitalia must be obligatory. We suggest that the family contains a great many more species unknown to science than those which are known and have been described. This applies particularly to the genus Leucopis.

It will be necessary to examine not only the genitalia but also the larval morphology, and to study the biology more thoroughly. It would be of great practical, as well as theoretical value to discover the trophic affinities, developmental cycles and behavioral characteristics of the Chamaemyiidae, for most of the species are effective entomophages and some of them play a very important part in keeping down the population of agriculturally harmful aphids and coccids.

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LABORATORY METHODS OF INVESTIGATING THE REPRODUCTIVE BIOLOGY OF FLEAS (APHANIPTERA)

A. N. KIR'YAKOVA

The role of fleas in maintaining and transmitting tularemia has now been proved and there is a suspicion that they play a part in transmitting a number of epidemic diseases such as encephalitis, Q fever and others. Interest in the biology and immature stages of fleas is therefore steadily increasing. The problems at issue can be solved only from a study of large numbers of many species—of living specimens. The problem of rearing fleas in the laboratory must therefore be dealt with. Since there is nothing on the subject in Russian and contemporary Soviet literature apart from Pavlovskiy's brief account of laboratory methods of rearing fleas (1927), we believe that both our own experience in this regard and the relevant works of foreign authors need to be publicized.

Bacot (1914) studied the influence of temperature and humidity on various stages in the life cycle of Xenopsylla cheopis Roths., Ceratophyllus fasciatus Bosc and Ctenocephalides canis Curtis.

Eskey (1934), Edney (1945, 1947a, 1947b), Hollenbeck (1946) and Bruce (1948) studied the biology of Xenopsylla hawaiiensis Jord, X cheopis Roths. and X. brasiliensis Baker. The last-named author also established the optimum temperature, humidity and nutrition for Ctenocephalides felis Bouché.

Scharif (1937, 1948a, 1948b, 1949) believed that +23°C and 80% relative humidity provided optimum conditions for the growth of Ceratophyllus fasciatus Bosc and established that dried horse blood with the addition of brewer's yeast was the best food for the larvae.

Ioff (1941) noted the importance of the combined effect of environmental temperature and humidity on the growth of flea larvae and considered that a relative humidity of 80-90% combined with a temperature of 18-24°C were the optimum conditions for larval growth. The larvae do not readily tolerate a moisture deficiency but will still continue to develop at 60, 65 or 70% humidity. Hecht (1943) reared fleas on a substrate of sand and powdered ox heart. Buxton (1948) pointed out that when Ceratophyllus fasciatus Bosc was fed on young mice oviposition started later and the number of eggs was smaller than in the control. He suggested that the mammal sex hormone was not transmitted to fleas during feeding on young mice. Burroughs (1953) established that certain species of fleas possessed the capacity to live for a long time under experimental conditions at temperatures of 10-20°C and relative humidity of 92-94%.

In our own work we have been trying to study the influence of various conditions on the growth of fleas. We were interested in the possibility of rearing fleas of the species under study in large numbers, so as to obtain the larval stage with minimum expense of time and trouble.

Ioff (1941) differentiates between "fur fleas" and "nest fleas". "Fur fleas", needing a frequent supply of blood, spend most of their time on the body of the host, whereas "nest fleas" attack the host only periodically. This peculiarity plays an important part in flea rearing and the methodology of obtaining larvae and pupae is worked out in the light of it.

We reared the following "fur fleas": Ceratophyllus (Nosopsyllus) fasciatus Bosc, 1801; C. (Monopsyllus s. str.) sciurorum Schrank, 1781; C. (Megabothris) turbidus Roths., 1909, and Ctenocephalides felis Bouche, 1835. The fleas were reared in glass jars 35-40 cm tall. A 5-8 cm layer of fine roasted pine sawdust was poured on to the bottom of the jars. The lower part of this layer (2-3 cm) was wetted with water to a condition of abundant moistness. This wetting is obligatory in summer but not in winter. The eggs always fall into the top layer of the substrate. To prevent the rodents from mixing it with the underlying sawdust and lowering the moisture content of the substrate we had to place a wire screening of sufficiently large mesh (0.5 x 0.5 cm) very carefully round the jar over the sawdust. A small piece of gray wadding (non-absorbent!) was put on the wire net so that the rodent could build its next. The host was kept permanently in the jar and fed there. As excess moisture is to be avoided, water should not be given, but the animal must be fed with bread abundantly moistened in milk. Oats and vegetables also form part of the host diet. The vegetable and bread residues must be cleaned out of the jar every other day so as to prevent the development of mold.

Several methods of feeding the fleas on the hosts were tried.

1. A white mouse with a cardboard or celluloid collar on its neck was put into the jar with the fleas. One to two hours afterwards it was taken out and the fleas that had settled on it were carefully collected. The animal was then put back in the jar.

2. The white mouse was transferred to a small wire cage (so as to prevent it from moving freely) and this was then put into the jar with the fleas. After one to two hours the cage was removed and the mouse carefully cleaned of fleas. In both cases the feeding of the fleas was repeated every other day. We soon had to give up feeding the fleas by these methods, for as there were ten culture jars it took a very long time to put the collars on the mice and take them off again, to look for the sated fleas on the host and so forth.

3. A more convenient method of feeding, which took up less time and gave good results, was to prepare the jars as indicated above, put the mice, with collars on, into them and leave them to make themselves at home in the jar for five to ten days. Owing to the feeding and natural excretions of the host the moisture content in the jar rose to 85-90% and a temperature of 18-20°C was established. After five to ten days fleas were put into this "lived in" jar along with the host. These preparations had created favorable conditions for the fleas to multiply.

A culture of Ceratophyllus fasciatus Bosc (rat flea) was successfully maintained on a white mouse. C. turbidus Roths. is primarily a yellow-throated mouse flea. A culture of this species was also fairly successful on a white mouse, but when the yellow-throated mouse was introduced into the jar the number of larvae, and consequently the number of adult fleas as well, multiplied so rapidly that a large proportion of them had to be urgently transferred to other jars to prevent the host's death.

Ceratophyllus sciurorum Schrank was reared on a forest dormouse. The animal was fed on oats and sunflower seeds and often given apples. C. sciurorum Schrank had not multiplied on white mice. We therefore had to allow for the host specificity of this species in rearing the fleas.

The flea eggs were very difficult to find in the sand and sawdust. In order to get eggs and make it easier to collect them we transferred the pregnant females (selected under the microscope) to a chemical test tube containing a small green bract from some plant (in order to maintain the moisture content) and closed up the tube tightly with a cork

stopper.

On the second day we had 30-40 eggs at our disposal but this was clearly insufficient for observations on larval growth. To obtain a larger quantity of eggs we used the following method. A small plywood box, shaped like a cylinder 16 x 20 cm, was made and laths were fastened 15-20 cm from its bottom with a piece of dark nappy tissue (flannel, cloth) buttoned or tacked to them; 5-8 cm above the first laths a second set of laths was attached and on these a 0.5 x 0.5 cm mesh wire screen was firmly secured. The host and the fleas were put into the cylinder on the screen. The flea eggs would roll down from the host's fur and fall on to the dark tissue fastened underneath, where they could easily be detected because of their pearly white color. The eggs were collected daily or once every two days in a Petri dish, where their growth could be observed.

In rearing Ctenocephalides felis Bouche we mainly used a method suggested by Linduska and Cochran (1946), but took kittens as hosts instead of dogs. On white mice the fleas died rapidly without ovipositing. Two-week-old kittens infested with 75-100 adult fleas each in a ratio of ten females to one male were kept in a wide-mesh Tishliyev cage. A piece of gray wadding was put in one corner and the rest of the wire floor was left bare. The kittens stayed permanently in the cage, which was placed in a spacious plywood box with a tightly fitting lid so that the box was always in semi-darkness. A sheet of thick wrapping paper, preferably not white, or a piece of dark nappy tissue (flannel, cloth) was placed under the cage. Wooden supports 5-8 cm high were set between the cage and the tissue or paper underneath it. The eggs rolled down freely from the hosts' fur on to the dark tissue or paper under the cage. They were swept with a brush once a day into a petri dish, where their subsequent development took place. 1500-3000 eggs were laid per day, so that at a temperature of 19-22°C and a relative humidity of 75-85% a large number of larvae could be obtained. An 0.5 cm layer of dry, sterilized, fine sand was poured on the bottom of the Petri dish.

The larvae were fed with dry powdered hematogen to which dry brewer's yeast had been added and sand was then mixed into this mixture. The hematogen was prepared by pouring liquid commercial hematogen into "basins" made by folding polyethylene bags so as to form rims and fastening these at the corners. After fifteen to twenty days the polyethylene was dried at room temperature (18-22°C) and easily removed in large lumps from the bottom of the basins. If iron, enamel or plastic basins were used the hematogen stuck to the bottom too firmly to be scraped off. Dried at room temperature hematogen does not lose its valuable nutrient properties. At higher temperatures its composition changes and it cannot be pulverized into a fine powder but only into small grains which are harder for the larvae to consume and assimilate. After drying out the hematogen was powdered in a porcelain mortar and very carefully mixed with powdered brewer's yeast. Up to 100 tablets of dry yeast were required for one bottle of liquid hematogen. The food consumed by the larvae was very dry. Brewer's yeast was added to the hematogen because of its valuable nutrient qualities (vitamins) and its capacity to absorb water from the surrounding air, thereby increasing the moisture content of the nutrient substrate.

In order to bring 400-500 larvae to the adult stage it was sufficient to mix one and one-half teaspoons of hematogen with brewer's yeast into the substrate. It was found best to introduce this ration in two doses: half a teaspoonful for 3-4 days, until the first stage larva emerged, then the rest for 8-10 days, when the most active, third stage larvae appeared.

The appearance of milk-white, barely mobile and later completely immobile larvae indicates the approach of the pupal stage. The larva is curved in the region of the second and third abdominal segments, so that the anterior and posterior body extremities approximate. It weaves a cocoon in which it molts. The pupae are immobile and therefore do not require special attention. It is desirable to keep the temperature at the former level (19-24°C); by comparison with the larvae, the pupae tolerate lower humidity. After 18-23 days adult fleas begin to appear. If the breeding is done in petri dishes the fleas are transferred into jars with the host; but if they are already in the jars with the hosts reproduction starts afresh.

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THE TROMBICULID MITES (CHIGGER MITES) OF THE GENERA DOLOISIA OUDEMANS, 1910 AND TRAUBACARUS AUDY ET NADCHATRAM, 1957 (ACARIFORMES, TROMBICULIDAE) FROM NORTH VIET-NAM

YE. G. SHLUGER, I. M. GROKHOVSKAYA, DAN VAN NGU, NGUEN XUAN HOE and DO KINH TUNG

Audy (1954) in a paper on the taxonomy of chigger mites of the family Trombiculidae, separated certain species of the genus Doloisia into a subgenus labelled "VN". Audy and Nadchatram (1957) subsequently elevated this subgenus into an independent genus Traubacarus.

Mites of the genus Traubacarus resemble those of Doloisia, from which they are distinguished by the presence of a single seta on the coxae of the first pair of legs (instead of three or four), by a small, very slightly sclerotized cephallic scutum and by the position of the posterior setae at the limits of the scutum.

According to Audy and Nadchatram the larvae of Traubacarus are parasitic primarily in the nasal cavities of various rats (they are most numerous on Rattus edwardsi Thomas, R. rajah Thomas, R. bowersi And. and R. alticola).

At present the genus Doloisia is represented by four species, Traubacarus by twelve. Two species of the genus Doloisia and two of the genus Traubacarus have been found in North Viet-Nam. In the present communication we describe the new species Doloisia alata, sp. n., Doloisia fulminans, sp. n., Traubacarus giganteus sp. n., and redescribe Traubacarus brachypus Audy et Nadchatram (1957).

Doloisia alata Shluger, Grochovskaja, Dang Van Ngu, Nguen Xuan Hoe et Do Kinh Tung, sp. n. (Figs. 1-7).

In the full-fed larva the body is oval or oblong-oval. The cephalic scutum is small, trapezoidal, with rounded anterior angles and posterior angles extended to form short protuberances. The anterior margin of the shield is slightly convex or sinuate, the posterior margin straight or very slightly rounded with a shallow median excavation, and the lateral margins are straight. Scutum sparsely and weakly punctulate. Anterior setae in scutal angles caudad to the median seta; posterior setae on apices of protuberances. Posterior setae with long sparse barbs, median seta with short barbs and anterior setae glabrous, slender and short (less than half the size of the posterior setae). Trichobothria pyriform, serrated in the proximal half and with short slender barbs in the distal half. Bothridia large, situated cephalad to bases of posterior setae. A sickle-shaped comb above each bothridium. Compound eyes lacking. Six humeral setae (3 on each side), 34-37 dorsal (in transverse rows with the following number in each row: 4-6(7)-8(9)-6(7)-6(2)-2) and 38(42 abdominal. Dorsal setae short, covered with long barbs. Legs of medium length; first pair (without coxae) 0.192-0.2 mm, second pair 0.153-0.17 mm and third pair 0.2-0.207 mm. Tarsi of third pair of legs four to four and a half times longer than their maximum width. Two solenidia on tibiae of first pair of legs (one near base, the other medially or apically). All setae on telofemur of first pair of legs plumose. The solenidium on the tibia of the third pair of legs is near the base. Solenidium lacking from metatarsus of third pair of legs. Coxae of first legs with three setae, of second legs with four (occasionally five), of third with ten to fourteen. Hypostomal setae glabrous. Setae on palpal femur and tibia of medium length, plumose; those on the metatarsus short; of the latter, the interior and exterior dorsal setae are glabrous, the exterior lateral ones plumose. Palpal claw seems to be divided into three points.

Body length of full-fed larva 0.681-0.725 mm with maximum width 0.444-0.518 mm.

Length of setae (in mm): anterior 0.016-0.02 (average 0.018), posterior 0.04-0.05 (average 0.044), median 0.026-0.032 (average 0.028), dorsal 0.033-0.043 (average 0.037) and abdominal 0.02-0.031 (average 0.026).

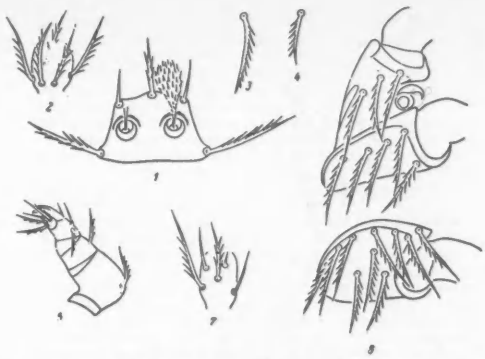
Taxonomy. Resembles Doloisia synoti Oudemans, 1910, from which it is distinguished by the absence of compound eyes, the greater number of dorsal setae and other characters.

Distribution and host. Found on the rat Rattus grochovskii D. Tien, in litt. in North Viet-Nam (Hongai, Halam).

Doloisia fulminans Shluger, Grochovskaja, Dang Van Ngu, Nguen Xuan Hoe et Do Kinh Tung, sp. n. (Figs. 8-16).

In the starved larvae the body is oval, greatly constricted in the anterior half and slightly constricted in the posterior half; in the full-fed larvae it is oblong. Cephalic scutum small, trapezoidal, with rounded anterior angles and posterior angles extended to form triangular processes. Anterior margin of scutum straight, posterior margin slightly rounded, lateral margins straight or slightly concave. Scutal punctation small and sparse. Posterior setae situated on apcies of prominences, anterior setae at the angles or near them, caudad to or on a level with the median seta. Anterior setae shorter and appreciably finer than the median and posterior setae, with sparse, fine barbs. Trichobothrium clavate, finely serrated in its narrow basal part, glabrous in enlarged distal part and bearing a tuft of short slender hairs only on the apex. Bothridia large, cephalad to bases of posterior setae. Bothridial combs forming sickle-shaped swellings. Compound eyes uniform, small, conspicuous not only in starved but also in replete larvae. Six humeral setae (three on each side), 30-36 dorsal (forming transverse rows with 6-8-8 (6)-8(6)-4(2)-2 in each row) 30-32 abdominal. Dorsal setae of medium length, covered with long barbs (these are often truncated, with the result that many of the setae appear serrated or even glabrous). Legs of medium length: first pair (without coxae) 0.192-0.207 mm, second pair 0.163-0.170 mm and third pair 0.207-0.222 mm. Length of tarsi of third pair of legs 4-4.5 times there maximum width. Coxae of first pair of legs with three setae, of second pair with five (occasionally four or six), of third pair with ten (sometimes eight, nine, eleven or twelve). One glabrous seta on telofemur of first pair of legs, the other four setae plumose. Two solenidia on tibiae of first legs (one near the base, the other near the middle). Solenidia lacking from metatarsus of third pair of legs. Palpal claw greatly curved, divided into two unequal teeth. Setae on palpal femur and tibia with fine barbs; all setae on palpal metatarsus short, slender, the exterior lateral one being plumose and the dorsal (interior and exterior) glabrous. Hypostomal setae fine and glabrous.

The starved larva is 0.207 mm long, with a maximum width of 0.148 mm; the replete larva can



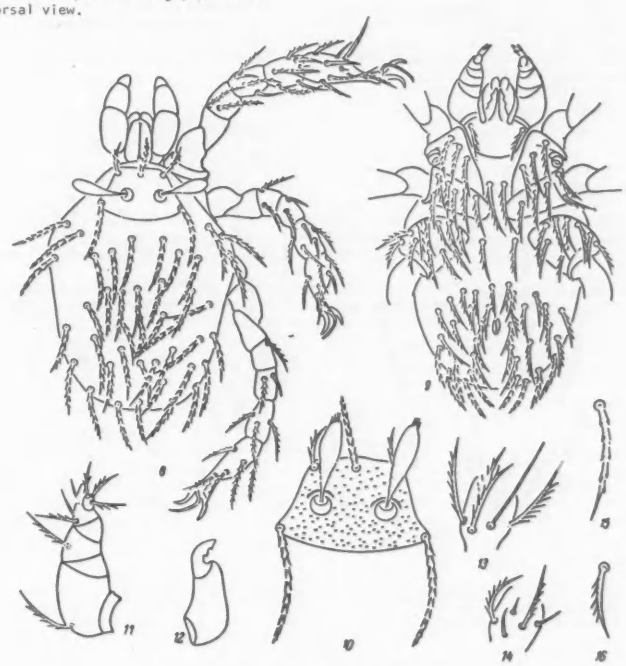
Figs. 1 - 7: Doloisia alata Schluger, Grochovskaja, Dang Van Ngu, Nguen Xuan Hoe et Do Kinh Tung, sp.n. 1 - cephalic scutum; 2 - telofemur of first pair of legs; 3 - dorsal seta; 4 - abdominal seta; 5 - palpus, lateral view; 6 - coxae of first, second, and third pairs of legs; 7 - tibia of first pair of legs, dorsal view.

District, Halam) and on the rat Rattus grochovskii D. Tien, in litt.

Traubacarus brachypus Audy et Nadchatram, 1957 (Figs. 17-24).

Audy and Nadchatram, 1957. Stud. Inst. Med. Res. Malaya, 28: 212-215; Audy, 1957. Parasitol., 47 (1, 2): 269.

When the larvae are replete the body is oblong-oval, with a slight constriction caudad to the third pair of legs. Cephalic scutum very small, slightly sclerotized (in some individuals it is impossible to determine the boundaries of the posterior and lateral margins of the scutum). Anterior margin sinuate or convex, posterior bilobed, lateral margins straight or concave, diverging posteriorly. Punctation lacking on scutum. Anterior setae fine, short (conspicuously finer and shorter than the median seta), situated on angles of scutum on a level with the median seta or slightly caudad to it. Anterior and median setae covered with sparse, fine barbs. The posterior setae lie outside the



Figs. 8 - 16: Doloisia fulminans Schluger, Grochovskaja, Dang Van Ngu, Nguen Xuan Hoe et Do Kinh Tung, sp.n. 8 - larva, superior view; 9 - larva, inferior view; 10 - cephalic scutum; 11 - palpus, lateral view; 12 - chelicera; 13 - telofemur, first pair of legs, dorsal view; 14 - tibia, first pair of legs, dorsal view; 15 - dorsal seta; 16 - abdominal seta.

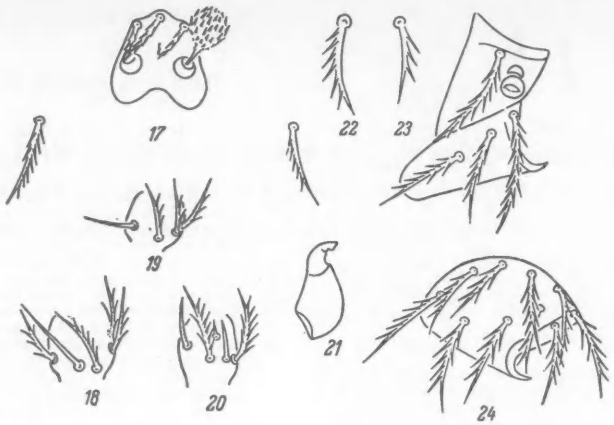
become as long as 0.858-0.962 mm and as wide as 0.577-0.651 mm.

Length of setae (in mm): anterior 0.02-0.26 (average 0.023), posterior 0.045-0.053 (average 0.049), median 0.028-0.036 (average 0.032), dorsal 0.038-0.05 (average 0.044) abdominal 0.028-0.045.

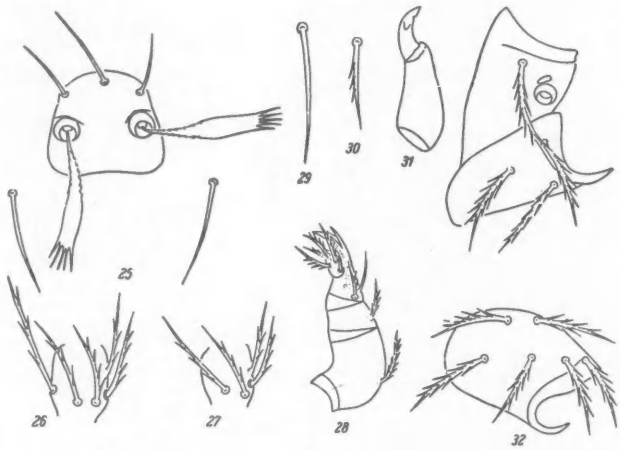
Taxonomy. Resembles Doloisia alata, sp. n., from which it differs in the presence of compound eyes and a bare seta on telofemur of first pair of legs, as well as by the longer dorsal setae, the shape of the trichobothrium and the greater size of the body and scutum.

Distribution and host. Occurs in North Viet-Nam (Hongai

scutum, on the soft integument of the body (roughly on a level with the postero-lateral angles of the scutum). Club of trichobothrium globose, covered with small fine barbs. Compound eyes not distinguishable. Six humeral setae (three on each side), 30 dorsal (forming transverse rows with 6-8-6-6-2-2 in each row), and 32-36 abdominal. Dorsal setae short, with long sparse barbs. Legs comparatively short: first pair (without coxae) 0.148-0.155 mm, second pair 0.118-0.126 mm, third pair 0.148-0.163 mm. Tarsi of third pair of legs 3.3-3.7 times as long as their maximum width. One glabrous seta on each telofemur of first and second pairs of legs (the remaining setae on these segments are plumose). Two solenidia on tibia of first pair (one in the middle,



Figs. 17 - 24: Traubacarus brachypus Audy et Nadchatram, 1957. 17 - cephalic scutum; 18 - telofemur, first pair of legs; 19 - telofemur, second pair of legs; 20 - tibia of first pair of legs, dorsal view; 21 - chelicera; 22 - dorsal seta; 23 - abdominal seta; 24 - coxae of first, second, and third pair of legs.



Figs. 25 - 32: Traubacarus giganteus Schluger, Grochovskaja, Dang Van Ngu, Nguen Xuan Hoe et Do Kinh Tung, sp.n. 25 - cephalic scutum; 26 - telofemur, first pair of legs; 27 - telofemur, second pair of legs; 28 - palpus, lateral view; 29 - dorsal seta; 30 - abdominal seta; 31 - chelicera; 32 - coxae of first, second, and third pair of legs.

the other not far from the base). Solenidia lacking from third metatarsus. Coxae of first pair of legs with one seta, of second pair with four (more rarely three), of third pair with ten (occasionally eight, nine or eleven). Seta on palpal femur plumose, on tibia glabrous; on the palpal metatarsus the exterior lateral seta plumose, the dorsal (interior and exterior) setae glabrous. Hypostomal setae bare.

Length of full-fed larva 0.444-0.562 mm with maximum width 0.281-0.370 mm.

Length of setae (in mm): anterior 0.013-0.019 (average 0.016), median 0.02-0.025 (average 0.022), posterior 0.025-0.033 (average 0.029), dorsal 0.024-0.038 (average 0.027), abdominal 0.018-0.026 (average 0.021).

Taxonomy. Differs from the Traubacarus brachypus type described from Malaya in having a bilobed posterior margin on the cephalic scutum.

Distribution and host. Found on the rats Rattus bowersi And., R. rajah Thomas and R. whiteheadi Thomas. It has been found in North Viet-Nam (Thai Nguyen and the Hongai Region, Halam) on R. grochovskii D. Tien, in litt.

Traubacarus giganteus Schluger, Grochovskaja, Dan Van Ngu, Nguen Xuan Hoe et Do Kinh Tung, sp. n. (Figs. 25-32).

When larva is fully fed, the body is oval or oblong. Cephalic scutum small, slightly sclerotized, resembling a trapezium with broadly rounded anterior and posterior angles; its anterior margin is convex, while the posterior margin has a shallow excavation medially and the lateral margins are straight. Anterior setae on angles of scutum, caudad to the median seta. Posterior setae lie outside the scutum. Anterior setae finer and shorter than median seta, and apparently glabrous. Trichobothria clavate, serrated in basal

half and split into three or four long slender points apically. Bothridia relatively large, situated on lateral margins of scutum. Strongly sclerotized sickle-shaped combs on bothridia. Compound eyes lacking. Six humeral setae (three on each side), 30 dorsal (in transverse rows of 6-8-6-6-2-2 in each row), 36 abdominal. Dorsal setae long, with very sparse rudimentary barbs (perceptible only when an oil-immersion lens is used for examining the larva), abdominal short, with readily distinguishable barbs. Legs comparatively long; first pair (without coxae) 0.252-0.266 mm, second pair 0.207-0.215 mm, third pair 0.259-0.266 mm. Tarsi of third legs five times as long as their greatest width. All setae on telofemora of first and second legs plumose. Two solenidia on tibiae of first pair of legs, one near the base, the other medially. Solenidia lacking on metatarsi of third legs. Coxae of first legs with one seta, of second with three setae and of third with seven (occasionally six). Hypostomal setae long and blabrous. Setae on palpal femur and tibia plumose. Dorsal setae (interior and exterior)on palpal metatarsus glabrous, extero-lateral seta plumose. Palpal claw divided into three points.

Length of full-fed larva 0.829 mm and greatest width 0.533 mm. Length of setae (in mm): anterior 0.022-0.025 (average 0.023), posterior 0.045-0.048 (average 0.047), median 0.036-0.043 (average 0.039), dorsal 0.043-0.058 (average 0.049), abdominal 0.03-0.046 (average 0.037).

Taxonomy. Certain structural details recall Traubacarus varmai Audy et Nadchatram, 1957, from which the species can be distinguished by the shape of the trichobothria, the presence of a plumose seta on the palpal tibia and other characters.

Distribution and host. Found in North Viet-Nam (Hongai Region, Halam) on rat R. grochovskii D. Tien., in litt.

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IN MEMORY OF V.M. BEREZINA (1899-1960)

V. N. STARK

Valentina Mikhaylovna Berezina, Candidate of Biological Sciences, a senior scientific assistant at the All-Union Institute for Plant Protection (VIZR), died on 23 December 1960 after a protracted illness (cardiac asthma). We have lost an important scholar and great expert on soil fauna at the height of her creative powers. Her death meant the loss of one whose classical work had greatly advanced the study of the ecology of May beetles and had provided the answer to the intricate problem of protecting pine plantations from some of the most harmful insects that attack timber.

Valentina Mikhaylovna was born in 1899 at Tver (Kalinin), where she attended the local gymnasium from 1911 to 1919. After working as an assistant on the Uman' forest estate in the Voronezh Guberniya in 1920, she joined the biological faculty of the Tver State Pedagogical Institute, from which she graduated in 1925. The subject of her diploma thesis was "Applied entomology in schools". In 1926 and 1927 she assisted A.I. Dobrodeyev at the State Institute of Experimental Agronomy, during which time she investigated pests in the Ryabov forest in the Leningrad region and in the Kalashnikov and Vyshnevologda forests in the Tver (Kalinin) region. In September 1926 she began to teach zoology and entomology at the Tver Forestry Technical High School, where she stayed until 1931, when she moved to the All-Union Institute for Plant Protection as a junior scientific worker in the forestry section. Hence-forward all her work was connected with the Institute's forest pest laboratory, and it was here that she completed her candidature thesis on "The effect of hydrothermal conditions on the May beetle", which she successfully defended in May 1939 at Leningrad State University. After acceptance of her thesis she was promoted to the position of senior scientific worker in the same laboratory and continued in this post until her death.

Her work at the Institute as a field ecologist took her on twenty-three expeditions concerned with the ecology of harmful soil entomological fauna and with the development and introduction of measures for the control of tree root pests. Her excellent training in general biology fitted her for research in her chosen field for thirty-five years, thirty of which were spent at the Institute. In particular, for many years she made a study of Melolontha hippocastani F., a most dangerous forest pest. As a result of her studies she produced an exhaustive account of the biology of the pest, which included full coverage of the world literature on this May beetle and related species. This enabled her to devise measures for the eradication of May beetle foci. She tested these measures for ten years in the Saval'skiy forest in the Voronezh region and they are now standard procedure in Soviet forests. As a result of this work this ancient enemy of forest plantations, which has limited the extension of forest plantations for many decades, is now no longer an obstacle to reforestation if the measures recommended are carried out. Berezina has thus provided a brilliant solution to one of the most difficult problems facing forest entomology. She was only able to solve this problem because she maintained a skillful balance in her work between extensive field ecological work and profound experiment and precise biochemical and physiological analyses. This enabled her to observe aspects of the behavior of the May beetle and to explain the connection between the insect and its environment. Thus, when studying the feeding habits of the larvae and imago on change of habitat due to weather conditions, she investigated changes occurring in the organism of the insect at different developmental stages in different habitats and thus solved the problem of the possible types of alternation of trees and shrubs. These studies make her recommendations for measures to reduce the numbers of the May beetle very convincing.

Berezina published her results in a series of articles and had recently been working on a treatise on the May beetle, in which she also intended to analyze the world literature, in which she was an expert. She was not able to complete this work: a few sections only have been published and another "The enemies of the May beetle from among the mammals" is ready in manuscript. A complete card index of the world literature on May beetles to the end of 1960, incorporating her notes, has been prepared. Berezina devoted all her strength and energy to the study of the May beetle. She worked with enthusiasm and without taking time into account. The cardiologist who attended her in her last illness was quite correct when he said that "she put her heart piece by piece into her work but forgot herself." She had scarcely recovered from a serious myocardial infarction in 1957 when, in 1958, she once again set out for field work in the Saval'skiy forest, since she was extremely interested in the fate of the May beetle population in localities where chemical treatment had been used. This work led to an article on intra-specific relations in Melolantha hippocastani F. published in this issue of the Journal.

These annual summer expeditions combined with the most intensive work on the expedition material during the winter led finally to a breakdown in her health and to her death. Even at the last, when seriously ill in hospital, she was still planning further research and the preparation of materials for publication, since she could not conceive of life outside her loved work. One can truly apply to her the tragic conception of her favorite composition, Tchaikovskiy's Sixth Symphony, which is devoted to the passionate searches and struggle for a full life of a man who threw down a challenge to harsh reality and exhausted himself in an unequal duel.

In addition to her work on the May beetle, Berezina also undertook extensive field studies and profound experiments on the root pests of shelter belt plantations. In the course of this work she assembled and analyzed the world literature on this group of pests and compiled an extremely complete annotated card index of the literature. Her studies of darkling beetles are also of great interest. This work is of considerable methodological interest, since its wide theoretical scope provides an excellent example of the way in which a study of the biology of the pest may lead to a successful new approach to the problem of control measures. These studies led to a method for the control of darkling beetles using combined baits which was tested under field conditions and has been adopted and included in the instruction leaflet of the Ministry of Agriculture as the main means of controlling the pest.

In addition to these groups Berezina made successful studies of the borers (Anobiidae), that are pests of pine and fir seeds. She also studied slugs.

Berezina did a great deal of research at Kamshina and Kamennaya Steppe on the formation of soil fauna in field shelter belts and showed how soil biocoenoses could be altered when transforming the steppe by afforestation measures.

It is a feature of her research that Berezina was not satisfied with existing methods and sought for new ways of solving the problems with which she was faced. She skillfully combined profound theoretical work with the solution of economic problems and this always provided solid backing for her conclusions. Her excellent knowledge of the major European languages and her ability to locate and make use

of the literature enabled her to make exceptionally wide use of world experience; she was a lover of books.

Another typical feature of Berezina's research is that every new work was a new step forward which seemed to sum up all her accumulated experience and raise new questions. This is especially noticeable in her last works (see Vols. VIII and XV of the collected papers of the All-Union Institute for Plant Protection). This feature reveals Berezina as a person at the height of her creative powers and continuing to advance.

It is certain that she has taken with her a whole world of new thoughts and interesting studies. I knew of her extensive plans for the future, the scope of which can be gauged from her last work on the role of mammals in the life of the May beetle. It is apparent from her manuscript that her extensive comparative analysis of the ecology of predator and prey had led her to the conclusion that "although no cases of the complete eradication of May beetle foci by predators alone have as yet been recorded in the literature, it is certain that if the May beetle was ever able to free itself of all its enemies, or even only of all its mammalian enemies, even the most highly perfected artificial measures would scarcely suffice to replace them. The possibility of making controlled use of natural enemies in May beetle foci entails the widest possible creation of favorable conditions for the predators and, which is equally important, measures to ensure that they encounter their prey more frequently. This can be ensured by a number of measures...." I am certain that Berezina's works will remain an example of this type of research for many years to come.

I must draw attention to one further trait in Berezina's character. She willingly shared her experience with the young people who came into contact with her in the course of her work and thus continually improved the knowledge of the junior scientific assistants in the laboratory. Her excellent style and great literary experience (she published forty-five papers) were freely at the disposal of her colleagues in the formulation of their papers, articles and theses. Many research workers from outlying districts and foreign scholars turned to her for advice. Her reply was always prompt and to the point.

As an excellent companion, and a modest and sympathetic person who made great demands both on herself and on those around her, Valentina Berezina did a great deal to create a friendly and efficient group in the laboratory, and her death is a great loss to it.

Berezina did a great deal of social work throughout her period at the All-Union Institute for Plant Protection and was for ten years the trade union organizer of the laboratory and for three years a member of the local committee and of the district committee of the Red Cross at the All-Union Institute for Plant Protection. She was repeatedly elected to the audit commission of the All-Union Entomological Society of which she became a member in 1934. During the great patriotic war she worked as a voluntary medical orderly in a military hospital, while at the same time taking an active part in the defence of Leningrad as the leader of an anti-aircraft defence detachment. I was often on duty with her on the roof of the All-Union Institute for Plant Protection during enemy air attacks on Leningrad and was always amazed by her restraint and self-control even when enemy aircraft were most active. Valentina Berezina received the Order of the Red Banner of Labor for long and satisfactory service and was also awarded the "Defence of Leningrad" and "Valiant Work in the Great Patriotic War" Medals and other honors. She often received prizes and commendations for her work in the All-Union Institute for Plant Protection.

When one loses such an important and valuable colleague one always wonders whether the seriousness of the loss is fully realized and how much that person's work was appreciated during his or her lifetime. It is certain that forest entomologists and specialists in wider fields have not as yet realized the full importance of Berezina's work and her contribution to a new approach to the study of insects that attack timber.

One thing is certain: a study of her works, especially by young people, will help us to make a fuller and more accurate study of the forest pests which were so close to our departed colleague and mong which she passed her life.

A LIST OF THE PUBLISHED WORKS OF V. M. BEREZINA

1. Forest pests and control measures in the Tver Guberniya. Izd. Tversk. gub. lesn. otd., 1927:1-45. (In collaboration with B. V. Grozdov).

2. Cone and seed pests of pines and firs in the Leningrad region. Tr. po zashch. rast., 1935, I(7):5-24.

3. Diagnostic charts of damage by insects that harm pine and fir cones and seeds. Tr. po zashch. rast., 1935, I(7):48-51.

4. The change in the entomological fauna of soils in relation to their conversion from steppe to forest. Itogi nauchno-issl. rabot VIZR za 1935, 207-211.

5. The area of Melolontha hippocastani F. in the USSR. Itogi nauchno-issl. rabot VIZR za 1935 g.: 28-31. (In conjunction with V. N. Stark).

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13. The effects of hydrothermal conditions in the soil on the vertical migration of Melolontha hippocastani F. larvae. Vestn. zashch. rast., 1940, 5:43-56.

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15. Regulations for the use of baits to control slugs on winter crop fields. Izd. VIZR, 1946:1-2.

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IN MEMORIAM VALERIAN PAVLOVICH NEVSKIY (1893-1951), ON THE TENTH ANNIVERSARY OF HIS DEATH

M. N. NARZIKULOV

Valerian Pavlovich Nevskiy, one of the Soviet Union's greatest experts on aphids, died on 1 December 1951.

With his death Soviet entomology lost not only an aphid expert but also an entomologist of wide outlook and an erudite organizer of agricultural pest control in Central Asia, where he spent thirty years (1921-1951).

Nevskiy was born on 21 January 1893 at the village of Mormuzhin in the Yaroslavskaya Guberniya. He obtained his secondary education at the Yaroslav seminary. In 1914 he joined the Natural Sciences faculty of the Shanyavskiy University, Moscow. In 1917, he was mobilized, but contracted tuberculosis of the knee joint and was released from military service. He went back to the University and graduated in 1918.

In the same year he was sent to Orenburg for koumiss therapy. Delayed at Tomsk, he began studying at the University there, at the same time working in the Institute of Textbooks in order to earn his living. He continued in this way until 1921, when he was sent to Central Asia for therapy. There he remained until the end of his life. Nevskiy worked as an entomologist first at the Turkestan entomological station, then at the Syr-Dar'ya entomological office, then at the Central Asian Institute of Plant Protection (SAIZR) and finally for ten years at the Plant Protection Station (STAZR) of the All-Union Institute for Scientific Cotton Research (Soyuz NIKhI). For fourteen years (1925-1939) he directed the orchard pest laboratory of the SAIZR and then became deputy scientific director (1939-1940) and finally director of the SAIZR (1940-1941). During the Second World War he was again appointed to direct the laboratory on orchard and mulberry pests (1942-1948). From the end of 1948 until the last days of his life (1951) he worked at the STAZR Soyuz NIKhI as an expert on orchard pests, particularly aphids.

Nevskiy's scientific activity was many sided and very closely bound up with the organization of fruit pest control in Central Asia.

His first research, started as far back as 1915, was on the biology of the wire worm Agriotes obscurus L. The results of this work were published in 1917 by the Shanyavskiy University Press, Moscow. All his later scientific works and papers were written after his move to Central Asia (Tashkent).

He researched on orchard insect pests and aphids.

His work on the aphid fauna of Central Asia and Southern Kazakhstan was particularly fruitful. He discovered about 230 species of the family Aphididae, no fewer than 93-95 of which proved to be new species. He established 11 new genera of aphids, of which the following received general recognition: Titanosiphon, Neanuraphis, Brevicorynella, Xerobion, Neaphis, Acaudella and Iziphya.

Nevskiy's monograph "Aphids of Central Asia" became so well known that it is quoted literally by all aphidologists throughout the world. His renown as a major aphidologist is consolidated in the generic and specific names of aphids that were proposed to honor him (Nevskya Mordv., 1932; Nevskyaphis Shap., 1950; Nevskyella Ossiannilsson, 1954; Xerophilaphis nevskyi Kreuzb., 1953).

Nevskiy is known not only as an aphid taxonomist but also as an entomologist with a wide interest in applied entomology. From the very start of his life in Central Asia he was interested in studying the biology of the main insects harmful to fruit, vineyards and gardens and in working out methods of combating them. For thirty years he headed all work on fruit pest control throughout Central Asia. The far from complete list of his works which appears below gives a clear picture of his wide scientific and practical interests. The key note of his career was his anxiety to help cotton and fruit growing, the main branches of agriculture in Central Asia, in all possible ways. This, however, far from exhausts the account of his scientific and practical work. He took an active part in many meetings and conferences on agricultural pest control and often contributed papers on the results and aims of fruit and other crop protection in Central Asia.

An important aspect of his work lay in education and training the younger generation of experts. From 1922 to 1929 he gave various training courses on plant protection, from 1931 to 1933 he was first Lecturer and then Reader in Entomology at the Tashkent (then Central Asian) Agricultural Institute and in 1933 until almost the end of his life he was Professor of Biology at the Central Asian State University. In 1935 his academic title of Professor was confirmed.

Exceptional modesty and simplicity, combined with a readiness to help his colleagues, were characteristic traits of Nevskiy's.

Despite heavy pressure of work he found time to answer his colleagues' letters promptly. No less valuable qualities in Nevskiy were that he made high demands both on himself and others, was an exceptionally hard worker and had a facility for performing different kinds of work simultaneously because he knew how to combine them.

Nevskiy's services to science and his country received recognition from the Party and Soviet Government more than once. He was decorated with the Orders of Lenin and the Badge and Medal of Honor and twice received the Diploma of the Supreme Soviet of the Uzbek SSR.

His memory, as of one who gave his whole life to the service of his country and Soviet science, will always be held dear by his pupils and successors and by the friends he made in his work.

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CURRENT EVENTS

THE WORK OF THE ALL-UNION ENTOMOLOGICAL SOCIETY OF THE ACADEMY OF SCIENCES OF THE USSR IN 1960

The most important event in the life of the All-Union Entomological Society during 1960 was the 4th Entomological Congress, which coincided with the Society's hundredth anniversary. Another important event in the year just ended was the attendance of the Soviet delegation at the 11th International Entomological Congress in Vienna.

1. Organizational Work

As of 1 January 1960 the All-Union Entomological Society had 1460 full members (including 13 honorary members) and nearly 50 candidate members.

During 1960, 162 full members and 2 candidate members were admitted to the Society. Professor A. N. Lyubishchev and Professor V. N. Shchegolev were elected to honorary membership by the Presidium. In 1960 the Society suffered grievous losses from the deaths of 20 members, including Professor V. V. Popov, who was a member of the Presidium and a corresponding member of the Academy of Sciences, USSR, P. P. Okunev, V. M. Berezina, P. P. Arkhangel'skiy and A. N. Luzhetskiy.

As of 15 December 1960 the Society had 1532 full members and nearly 50 candidate members.

The honorary members of the A-UES are: Professor E. G. Bekker, V. N. Beklemishev (a full member of the USSR Academy of Medical Sciences), Professor I. V. Vasil'yev, Ye. V. Zverozomb-Zubovskiy (a corresponding member of the Academy of Sciences of the Ukrainian SSR), L. P. Kalandadze (a full member of the Georgian Academy of Agricultural Sciences), Professor A. N. Kirichenko, Professor A. I. Kurentsov, Professor S. G. Lepneva, Professor A. N. Lyubishchev, Professor S. I. Medvedev, Academician Ye. N. Pavlovskiy, Professor V. N. Stark, Honored Scientific Worker Professor D. M. Fedotov, Professor A. A. Shtakel'berg and Professor V. N. Shchegolev.

As of 15 December 1960, the All-Union Entomological Society had 16 functioning sections: Moscow (163 members, Chairman D. M. Fedotov [Honored Scientific Worker and an Honorary Member of the A-UES]), Siberia (108 members, Chairman Dr. A. N. Cherepanov), Voronezh (54 members, Chairman Professor P. A. Polozhentsev), the Far East (47 members, Chairman Professor A. N. Kurentsov [Honorary Member of the A-UES]), Rostov (47 members, Chairman V. P. Romanova [Candidate of Biological Sciences]), Ivanov (18 members, Chairman N. V. Khelevin [Candidate of Medical Sciences]), the Ukraine (200 members, Chairman Professor V. P. Vasil'yev [Vice President of the A-UES]), Belorussia (43 members, Chairman G. G. Bezdenko [Candidate of Agricultural Sciences]), Uzbek (134 members, Chairman Professor V. V. Yakhontov [Corresponding member of the Uzbek Academy of Sciences]), Kazakh (45 members, Chairman Professor S. A. Kharin), Georgia (114 members, Chairman Professor L. P. Kalandadze [Member of the Georgian Agricultural Academy and an Honorary Member of the A-UES]), Moldavia (41 members, Chairman Professor Ya. I. Prisla), Latvia (30 members, Chairman Professor E. Ya. Ozols), Turkmenia (29 members, Chairman A. N. Luppova [Candidate of Biological Sciences]), Azerbaydzhan (47 members, Chairman N. G. Samedov), Kirgizia (25 members, Chairman Professor S. P. Tarbinskiy). There are also two sections (Sakhalin and Sochi) which have not functioned owing to lack of members and fluctuations in membership and which did not reelect their chairmen and committees for 1960. It would clearly be desirable to merge these sections with the territorial adjacent Far Eastern and Rostov sections. The Azerbaydzhanian section was formed in 1960.

Six meetings for members of the A-UES were held in Leningrad in 1960; 11 papers were presented at these meetings and there was a screening of the film "Soil insects". One of the meetings was a joint meeting with the Zoological Institute of the Academy of Sciences, USSR. Particular interest was shown in papers by the President, Professor Pavlovskiy ("The results of the 11th International Entomological Congress in Vienna"), N. G. Berim ("The problem of overcoming the resistance of insects to poisons") and Dr. Skugravi (Czechoslovakia) ("Study of the zoocoenoses of cultivated fields in Czechoslovakia"). The meetings of the Society were attended by between 19 and 102 members (more than 50 on average). The meetings discussed biological and chemical pest control, the study of biocoenoses, insect physiology and photography and reports on congresses and symposia. Although one cannot be satisfied with the number of meetings held in Leningrad, it should be remembered that a great many papers were presented in 1960 to the 4th Congress of the A-UES.

The 13th traditional series of lectures in memory of N. A. Kholodkovskiy was given in April 1960. Papers were delivered by Academician Pavlovskiy ("The history of the discovery of the role of lice as parasites and carriers of the agents of parasitic typhoid"), Professor Rubtsov ("Interrelationships of the soft scale and its parasites and symbionts") and I. K. Teravskiy ("Morphology of the hemolymph of the Argasidae").

At their 6 meetings in 1960 the Committee and Presidium of the A-UES dealt, inter alia, with the results of the 4th All-Union Entomological Congress, attendance at the 11th International Entomological Congress, the organization of sections and branches and membership applications. One new departure was that the Society's Presidium called a plenary session of the Committee in Leningrad in November to hear the papers to be presented at members' meetings and to discuss major scientific and organizational questions (the draft resolution of the Presidium of the Academy of Sciences, USSR, on the attendance of Soviet entomologists at the 11th International Entomological Congress in Vienna, a report by the Society's Vice President Professor Bey-Biyenko on the decisions of the Academy's Presidium on the results of the 4th Congress of the A-UES, a report by the Society's Constitution, the sections and branches and other matters).

The new Committee elected at the 4th All-Union Entomological Congress consisted of 40 members (see "Entomologicheskoye obozreniye", Vol. 39, No. 2, 1960, page 479 for a more detailed report).

The working members of the Society's Presidium were as follows: Academician Ye. N. Pavlovskiy (President), corresponding member of the Academy of Sciences, USSR, G. Ya. Bey-Biyenko (Vice-President), Professor D. M. Shteynberg (Vice-President), Professor V. P. Vasil'yev (Vice-President), Corresponding member of the Academy of Sciences, USSR, Professor V. V. Popov, Professor A. V. Gutsevich, Professor M. Ye. Ter-Minasyan, Professor A. A. Shtakel'berg, the Deputy Director of the VIZR, Ye. M. Shumakov, the Head of the Entomological Faculty of Leningrad University Docent A. S. Danilevskiy, K. Ya. Grunin (Treasurer) and V. I. Tobias (Scientific Secretary).

2. The 4th Congress of the All-Union Entomological Society

The Congress, which was timed to coincide with the Society's 100th anniversary, was held in Leningrad between 26 January and 1 February 1960. More than 250 scientific

and economic bodies, institutes of higher education and museums from 90 towns in the USSR took part in the Congress, which was attended by more than 700 entomologists. The delegates heard and discussed 168 papers. The scope of the Congress was fully covered in the two volumes of abstracts that were published in advance and in the resolution adopted by the Congress and since published. The Congress decisions, which were reported to the Presidium of the Academy of Sciences, USSR, by the Society's Vice President Professor Bey-Biyenko, were approved by the Presidium (see "Entomologicheskoye obozreniye", Vol. 39, No. 2, 1960, and "Resolutions of the 4th Congress of the All-Union Entomological Society, 26 January–1 February, 1960", Leningrad, 1960, for a more detailed account of the 4th Congress).

3. Attendance at the 11th International Entomological Congress in Vienna

Organization of the attendance of its members at the 11th International Entomological Congress in Vienna was an important aspect of the Society's work. Preparation was entrusted to an organizing committee of 9 members (Chairman Academician Ye. N. Pavlovskiy, Deputy Chairman Professor Bey-Biyenko and Professor Gilyarov, Secretary A. G. Sharov and others). The aim was to send as many leading members of the Society as possible and to include representation of the sections and of the younger generation of entomologists. As a result of these efforts the Congress was attended by 31 people, including the chairmen or deputy chairmen of 8 sections (Azerbaydzhan, Georgia, the Far East, Latvia, Moscow, Siberia, Uzbekistan and the Ukraine). Papers were presented to the Congress by Bey-Biyenko, Borkhsenius, Vasil'yev, Gershenzon, Getsova, Gilyarov, Zvereva, Kalandadze, Kalugina, Kobakhidze, Kurentsov, Martynova, Mazokhin-Porshnyakov, Ozols, Samedov, Terteryan, Khaberman, Yakhontov and Cherepanov.

Some of those who attended the Congress took advantage of their stay in Vienna to contact scientific establishments concerned with entomology and plant protection and, in some cases, to work in them. In particular, various people worked on the collections of the Vienna Natural History Museum (Arnol'di, Bey-Biyenko, Borkhsenius, Gur'yeva, Zagulyayev, Kobakhidze, Ozols, Popov, etc.).

On the whole the journey of a large group of Soviet entomologists to Vienna was useful and valuable since personal contacts were established with many foreign scholars, the strong and weak sides of Soviet entomology were revealed (one weakness is the relative lack of scientific equipment in many Soviet institutes dealing with entomology, and insufficient use of new research methods, including the use of films and tape recorders in insect morphology and physiology), and various taxonomic problems were solved by work in the Vienna Natural History Museum.

Particular mention should be made of the great interest shown by foreign entomologists in the Soviet Union and the persistent requests that one of the next international entomological congresses should be held in the USSR.

4. Publications

During the year covered by the report "Entomologicheskoye obozreniye" published 90 papers by 99 authors with the following breakdown by subject: general aspects of entomology–5 papers, morphology, anatomy and embryology–7 papers, biology–28 papers (9 on agricultural pests, 6 on pests of medical and/or veterinary significance, 4 on forest pests, 2 on biological pest-control methods and 2 on storage pests and pests that attack manufactured goods), faunal studies and zoological geography–12 papers, taxonomy–39 papers (12 on Diptera, 6 on Coleoptera, 5 each on Lepidoptera and Hymenoptera, 3 on Acaridae, 2 on Plecoptera and 1 each on Hemiptera, Ephemeroptera, Trichoptera and Phasmida).

Of these papers 39 came from Leningrad, 19 from Moscow, 5 from Kiev, 2 each from Novosibirsk, Pushkin (Leningrad region), Tomsk, Khabarovsk and Khar'kov and 1 each from Alma-Ata, Baku, Bork (Yaroslavl region), Voronezh, Yerevan, Ivanov, Irkutsk, Kizlyar, Kishinev, Novosibirsk, Petrozavodsk, Samarkand, Stavropol, Stalinabad, Stolbov (Krasnoyarsk subdistrict), Tartu, Tashkent and Chita; two foreign contributions came from Pekin and one each from Budapest, Warsaw and Hanoi.

In addition to the scientific papers, the Current Events section carried 8 reports on the activity of the All-Union Entomological Society and its sections, reports on the 4th All-Union Entomological Congress in Leningrad and on entomological meetings and international symposia, etc. Criticism and bibliography was increased, by comparison with the previous year, and 12 reviews were published.

There is a catastrophic increase in the number of papers held for publication by the editorial board of "Entomologicheskoye obozreniye" (the Board already has material deemed worthy of publication sufficient to fill issues for for the next two and one half years), but we have not been able, despite repeated attempts, to secure an increase in the size of the journal: there has, as yet, been no practical outcome of the resolution of the 4th Congress, which was endorsed by the Presidium of the Academy of Sciences, USSR, and the allocation for 1961 (60 printer's 'listy' [1 'list' = 1 1/2 x a 60 x 92 cm sheet of paper] remains the same as in 1960.

5. The Society's Library

The library of the A-UES is the most important entomological library in the USSR. On 7 December 1960 there were 57,813 items in the holdings.

During the year 1501 publications were added to the library: 1147 of these were obtained by exchange, subscription, purchase and gift and 354 from the library of the Academy of Sciences.

Of these items 501 were Soviet (including 205 issues of periodicals) and 1000 were foreign (including 658 issues of periodicals); 638 items were monographs published in occasional publications or as separate collections.

We have exchange relations with 40 institutes and societies in 15 countries (Australia, Austria, Great Britain, the GDR, Holland, the UAR, Indonesia, Poland, Rumania, the USA, Finland, France, Czechoslovakia, Sweden, Yugoslavia and Japan). The Society's library receives 6 journals from the USA, 5 each from Poland and Japan, 3 each from Great Britain and Finland, 2 each from Holland, Rumania, France, Czechoslovakia and Yugoslavia and one from each of the other countries.

The library was used by 388 readers in 1960 and 8197 books were issued. It should be remembered that the library was removed for a considerable part of the year, owing to capital repairs to the Zoological Institute of the Academy of Sciences, USSR.

6. The Work of the Sections of the A-UES

The Society's sections are scientific and organizational centers for entomologists from different institutes and branches of the national economy, which organize exchanges of experience, the coordination of work and popularization of entomological knowledge. The majority of the sections functioned actively in 1960. Particular mention should be made of the excellent work of the Ukrainian, Siberian, Uzbekistan, Moscow, Latvian, Ivanovo, Far Eastern, Georgian and Moldavian sections.

The large Ukrainian section was very active. Its regional units held 55 meetings at which 60 papers were delivered. Members of the section gave 4000 consultations, 653 scientific and popular lectures and wrote 197 popular articles and 2 books. In late 1959 the section convened the Ist Ukrainian Entomological Conference in connection with the Society's 100th anniversary. The section helped to organize and run a scientific conference (7-10 December, 1960) on the chemical control of pests, plant diseases and weeds. More than 100 of the Society's members attended the conference. The section is devoting a great deal of time to preparation for the 4th ecological conference.

The Siberian section has 7 branches in Novosibirsk, Omsk, Kurgan, Tomsk and Krasnoyarsk and an Altay branch; its members live in 24 Siberian towns. This territorial dispersion did not prevent the section from functioning actively. Members of the section gave 40 lectures and 220 consultations to agriculturists and forestry workers and held 13 seminars. The section cooperated with the Biological Institute of the Academy's Siberian section and with the Siberian section of the Microbiological Society in organizing and running a meeting on microbiological control methods

for agricultural and forest pests and a symposium on the Siberian pine moth (Dendrolimus sibiricus). The second Urals and Siberian zone planning and methods conference for the coordination of research on plant protection and plans for the introduction of scientific achievements was attended by 24 of the Society's members.

Moscow entomologists took an active part in the work of the 4th All-Union Entomological Congress and the 11th International Entomological Congress in Vienna. They were responsible for many interesting papers, a high proportion of which dealt with a wide range of scientific problems.

The Uzbek section has done a great deal to popularize entomological knowledge. The section arranged 615 lectures and consultations in collective and state farms and other establishments and identified 252 insects. One interesting and useful accomplishment by the section has been the production of a special enquiry form for distribution among the Society's members in the section. The object of the questionnaire is to provide a record of the member's scientific work and his activity in popularizing entomology and to help to improve this work. Because of a considerable rise in membership, the section committee has been able to set up two new centers (branches) at Samarkand and Andizhan.

The Ivanovo section has done a great deal to popularize entomological knowledge. This small section has been responsible for 47 lectures, 4 broadcast talks and 10 popular science articles in the press.

The Far Eastern section has taken the interesting step of drawing up an outline plan of its work for the next three years. The scope of the plan is extremely varied. The Presidium of the A-UES has circulated this plan to all sections as an example of what can be done.

The Latvian section has been active. Members of the section have delivered 16 papers at 9 meetings and two numbers of "The Latvian Entomologist" ('Entomolog Latvii') have been published.

Although only founded in 1960, the Azerbaydzhanian section has grown rapidly. The number of entomologists who are full members of the A-UES more than doubled during the year and the section's members were responsible for nearly 60 papers on various entomological problems.

The most important event in the Society's work in 1960 as a whole was the 4th Congress. Mention should also be made of the rise in membership, the increased activity of some sections, especially in popularizing entomological knowledge, and the establishment of closer links between the Presidium and the sections.

Weaknesses in the Society's activity include the failure to hold enough scientific meetings either in Leningrad or in the sections and the fact that the publishing program is behind schedule.

The published resolution of the 4th Congress is an important guide for the Society's activity and for the general development of Soviet entomology.

The Presidium of the All-Union Entomological Society

THE XIth INTERNATIONAL ENTOMOLOGICAL CONGRESS IN VIENNA

G. YA. BEY-BIYENKO

The periodic convening of international entomological congresses is now an established tradition. This is a typical feature of the present stage in the development of entomology as an extensive field of research that makes an important contribution to the understanding of nature and that is of increasing practical importance.

The XIth International Entomological Congress, which was held in Vienna between the 17th and 25th of August 1960, was attended by more than 1800 persons from some 60 countries. Professor-Doctor K. E. Schedl was the Chairman of the Congress, Dr. K. Holdhaus, the eminent zoogeographer, was the Vice-Chairman and Dr. M. Beier, an eminent expert on the taxonomy of the Orthoptera and Pseudoscorpionida and the head of the entomological department in the Vienna Natural History Museum, was the General Secretary.

Preparations for Soviet attendance at the Congress were commenced in late 1959, when the All-Union Entomological Society set up a special organizing committee. The committee's task was to arrange for active members of the Society, especially members of its sections and entomologists from the younger generation, to attend the Congress. The party of 31 arranged by the Society included members of its Presidium (Academician Ye. N. Pavlovskiy, the Chairman, G. Ya. Bey-Biyenko and V. P. Vasil'yev, Vice-Chairman, and V. V. Popov), representatives of a number of the Society's sections — Moscow (Ye. E. Bekker-Migdisova, G. A. Viktorov, M. S. Gilyarov, O. M. Martynova, G. A. Mazokhin-Porshnyakov and A. G. Sharov), Siberia (the Chairman of the section A. I. Cherepanov), the Far East (the Chairman A. I. Kurentsov), the Ukraine (the Chairman P. P. Vasil'yev and S. M. Gershenzon), Uzbekistan (the Chairman V. V. Yakhontov and R. A. Alimdzhanov), Georgia (the Chairman L. P. Kalandadze and D. N. Kobakhidze), Latvia (the Chairman E. Ya. Ozols), Azerbaydzhan (the Chairman N. G. Samedov), and a number of full members of the Society from Leningrad (L. V. Arnol'di, N. S. Borkhsenius, N. G. Bregetova, A. B. Getsova, Ye. L. Gur'yeva and A. K. Zagulyayev), Tartu (Kh. M. Khaberman), Syktyvkar (O. S. Zvereva), Yerevan (A. Ye. Tertertyan) and other places.

In addition, a number of full members of the Society attended the Congress on behalf of other Soviet institutions. Thus, the group from the Moscow institutes of higher education included Ye. M. Bulanova-Zakhvatkina, B. V. Dobrovol'skaya, N. S. Kalugina, F. N. Pravdin, O. A. Chernova, I. Kh. Sharova and others. The group from the research establishments of the All-Union Academy of Agricultural Sciences and other specialized academies included experts on plant protection (I. D. Batiashvili, T. . Grigor'yeva, A. A. Yevlakhova, I. A. Zrazhevskiy, Ye. M. Shumakov, N. A. Glushenkov and V. A. Shchepetil'nikova) and on medical and veterinary entomology— K. N. Andreyev, G. I. Kanchaveli, G. I. Netskiy, etc.

More than 50 Soviet scholars attended the Congress. By comparison, there were only 7 Soviet representatives at the preceeding Xth Congress in Montreal (Canada) in 1956, and at earlier entomological Congresses there had either been fewer Soviet representatives or none at all. Even so, the Soviet party was considerably smaller than the parties from some other countries. The report of the Credentials Commission showed that the largest number of participants (more than 200 each) came from the USA, Britain and the Federal German Republic; France sent more than 120 and Canada as many as 60. In the light of the present state and development of various branches of entomology in the USSR and the international role which Soviet entomology as a whole can play, it is clear that Soviet participation in future international entomological congresses must be further increased.

The majority of those who attended the Congress went at their own expense as tourists with facilities provided by "Intourist"; only a few individuals were accredited by scientific and other institutions. Both tourist groups flew by TU-104 from Moscow; the group organized by the All-Union Entomological Society reached Vienna in the morning two and one half hours after take-off and were met by the General Secretary of the Congress, Dr. M. Beier, and his wife, who was herself a member of the Congress organizing committee as the organizer of the ladies' program. We learned from Dr. M. Beier that many of those attending the Congress, including some of the people whom we wished to meet, had already arrived in Vienna. Delegates began to register on 16 August in the morning in the building of Vienna University. After paying the Congress fee of 500 Austrian schillings, each participant received a prepared folder of official documents and other materials including credentials, the program, a list of those attending the Congress and their addresses in Vienna, a cardboard badge showing the name, academic qualification or degree and country of the participant, a special number of the Oesterreichische Hochschulerzeitung devoted to the Congress and including a great many articles on various aspects of entomology, a map of Vienna showing tramway routes and other means of transport, guides to museums and theaters and various advertisements.

The Work of the Congress

The Congress opened at half past ten on the morning of 17 August in the Hofburg (Fig. 1) and the sections and symposia began work at two o'clock, at which time the special film program also commenced. In the evening the Mayor gave a reception for those attending the Congress at the civic center. Most of the work of the Congress was carried out in Vienna University (Fig. 2) and, in part, in the Vienna Natural History Museum not far away; this was most convenient for the delegates (Fig. 3), who were able to go quickly from one building to the other as occasion demanded.

The time at which papers should be presented and the length of papers was strictly laid down in the program; the majority of speakers were allotted 30 minutes, including time for questions and discussion, but this was sometimes varied to 15-25 or 45 minutes in relation to content. The halls in which the sessions were held were equipped with projection apparatus for photographs and slides, and even sometimes for films. This was of great assistance in the presentation of materials relating to papers; wall charts were not used. Secretaries and chairmen were appointed in advance for each section and symposium; the secretaries functioned for the whole meeting and the chairmen for a single session. The sections and symposia normally worked from 8 to 12 in the morning and continued from 2 to 6 after a two hour lunch break. The working languages were German, English and French, but the majority of papers were presented in German and English; there were no translators, but during discussion, which began with questions and could be conducted in the languages already mentioned, the speaker was sometimes obliged to ask the Chairman or other persons present for assistance in translation. Short summaries of the papers were duplicated before the Congress began and made up into folders by subject matter and the section or symposium to which they were presented. These summaries could be obtained by attending the session. Unfortunately, some papers were missing from the published

Fig. 1 - At the Hofburg on the day Congress opened; the flags of countries participating in the Congress are displayed. Photograph by Ye.M. Shumakov.

Fig. 2 - Vienna University

summaries. The text of a paper was delivered to the Secretary or Chairman of the section for subsequent publication in the Congress "Proceedings".

The scientific program of the Congress was very extensive and covered all the most important branches of entomology and related subjects. The program also included general and special excursions and attendance at receptions.

There were only two plenary sessions — the opening session of the Congress on 17 August addressed by the Chairman, Professor Schedl, and other individuals, and the official closing on the morning of 25 August. All the remaining sessions were conducted in the 14 sections and 17 symposia and at screenings of special films.

The Work of the Sections

The work of the Congress was undoubtedly dominated by section 1 (Taxonomy and Paleontology), the Secretaries of which were Dr. M. Beier and Dr. G. Schoenmann. It heard more than 100 papers, which were mainly divided on a taxonomic basis into 7 subsections: 1a - insects with incomplete metamorphosis (23 papers), 1b - Coleoptera (18 papers), 1c - Lepidoptera (9 papers), 1d - Diptera (20 papers), 1e - Hymenoptera (11 papers), 1f - Arachnida (12 papers, mainly on ticks) and 1g - paleontology (6 papers).

There was one joint session devoted to general questions, which was extremely interesting. Unfortunately, it had not been realized how much attention it would attract, since it was held in a small room and it was difficult for all who wished to do so to attend. Five papers were presented to the Joint Session. There was great interest in a paper by Dr. H.J. Stammer (FGR) entitled "New approaches to insect taxonomy", although it did not contain anything that was new to Soviet workers. He dealt with "the old" and "the new" taxonomy. The old, 19th century taxonomy was based on purely morphological treatment of problems of classification and taxonomy from dead museum specimens. The new taxonomy should be wide-ranging and should draw on larval morphology, cytology, genetics, biology, ecology, geography, insect paleontology, etc. The paper did not, however, examine the need for functional analysis of morphological structures, which is a method that has given outstanding results in the hands of Kovalevskiy, who introduced it into vertebrate paleontology as early as the end of the 19th century, and of Martynov, as applied to insects.

Fig. 3 - A group of delegates. Left to right: Dr. W.E. China (London), Mrs. F. Evans (Sidney, Australia), Dr. J.W. Evans, Dr. de Melo Carvalho (Brazil), the President of the Royal Entomological Society of London, Prof. B.P. Uvarov (London), Dr. G.W. Beiers (Lawrence, USA), Mrs. A.F. Uvarov, O.M. Martynova (Moscow), Prof. G.Ya. Bey-Biyenko, Prof. F.E. Zeuner (London), Dr. F. Bachmaier (Vienna). Photograph by N.S. Borkhsenius.

There was great interest and much dispute over the paper by R. R. Sokal (USA), "The principles of quantitative taxonomy", devoted to the use of electronic computers in objective evluation of the relationships of species. Many of those who heard it were highly critical of this paper, although, in my opinion, without foundation: electronic computers can, on course, assist progress in taxonomy, and the question is not one of replacing the higher analytical and systematizing functioning of the human brain, but of using a new and up-to-date research method by devising well thought out programs and tasks for these machines. These programs and tasks can only be worked out by the brain of a capable expert on taxonomy, i.e., a research worker of standing. Therefore, one is not "handing over" taxonomy to computing devices, but is employing them on taxonomy.

Dr. A. Nielsen (Denmark) suggested that the Arthropoda originated on land in his paper, "Some thoughts on the phylogeny of the Arthropoda". Professor A. Peterson (USA) accompanied his paper, "Technical methods employed in the identification of insect eggs" with a series of magnificent colored photographs of eggs.

Among the many people who took part in the discussion of these papers were the Soviet entomologists Ye. E. Bekker-Migdisova, M. S. Gilyarov and A. G. Sharov; they spoke of the relationship between phylogeny and taxonomy, and the role of ecological methods and the study of larval forms in solving taxonomic problems. Gilyarov argued in detail against A. Nielsen.

Many papers included in the programs of the subsections were devoted to finer points and special problems. One of the most general papers in subsection 1a (Insects with incomplete metamorphosis) was Sharov's "On the classification of orthopterous insects", in which he demonstrated from paleontological data the absence of any basic distinctions between the Permian Protorthoptera and the Mesocenozoic Orthoptera; nevertheless the former should be treated as an independent antecedent order. Dr. R. Ebner (Austria) presented a paper on "The Phasmida as insectary animals", and Professor D. K. Kevan (Canada) spoke on "The taxonomy and distribution of the Atractomorphini", a tribe of locusts from the tropics and subtropics of the Old and New Worlds, which it is very difficult to identify. A number of papers on the taxonomy of the Hemiptera were also presented to subsection 1a by Dr. C. de Melo Carvalho (Brazil), Dr. R. Matsuda (USA), Dr. P. Stys (Dzechoslovakia) and others. These papers touched on the taxonomy and world catalogue of the Miridae, the use of venation in taxonomy, the morphology of the female abdomen and genitalia and other subjects. The more general papers on the Homoptera included one by Professor N. S. Borkhsenius on a new classification for Coccoidea of the family Asterolecaniidae and one by Dr. J. W. Evans (Australia) on the factors associated with the origin of the higher taxonomic categories of leafhoppers.

After the first session of subsection 1a on the Orthoptera we were able to assemble some, although unfortunately not all, of the specialists on this subject in the university grounds for a photograph (Fig. 4).

I was not able to attend the other subsections and shall therefore confine myself to a few remarks based on the program and abstracts and on the comments of my colleagues.

Many of the 18 papers delivered in subsection 1b (Coleoptera) were concerned with minutiae. More general papers worthy of mention include those presented by Dr. W. H. Anderson of the USA ("Progress in the classification of the Rhynchophora"), Dr. G. Nonveiller of Yugoslavia ("On the formation of races and species in Rhizotrogini"), Miksic of Yugoslavia ("The capricorn beetle fauna of Yugoslavia"), Dr. E. Voss of the FGR ("Orchid weevils") and a paper entitled "Morphological and ecological types of ground beetle larvae" by the young Moscow entomologist T. Kh. Sharova. The need for thorough study of the biology, ecology, morphology, anatomy and taxonomy of the Coleoptera was the common factor in all these papers and in the work of the subsection as a whole.

Subsection 1c (Lepidoptera) met twice. One of the most important papers presented was that by Dr. A. Diakonoff (Holland) on "The classification of leaf-rollers". The paper by Professor F. Heydemann (FGR) "Geometridae of the genus Ortholitha Hb. as an example of evolutionary theory" was based on the assumption that detailed study of a genus may yield much of interest to evolutionary theory. In these and other papers it was stressed that when studying the taxonomy of the Lepidoptera one must make use of a wide range of attributes, including the chaetotaxy of the caterpillars and pupae, as well as of biological features, and especially food specialization; one-sided use of the morphological features of the imago or the genital apparatus leads to formal classificatory outlines.

In this subsection Dr. H. G. Amsel (FGR) also held a meeting of authors of the multi-volumed "Microlepidoptera Palaearctica", which should appear in the course of the next 10-15 years. I regret that no Soviet specialists are concerned with this publication.

The fact that subsection 1d (Diptera) had more meetings (4) and heard more papers (20) than any other subsection undoubtedly reflects the present great interest in the Diptera throughout the world. The meetings of the subsection opened with a paper by Prof. Dr. B. B. Rodendorf (Moscow) "New data on the taxonomy of the Diptera"; unfortunately, Rodendorf was not present at the Congress and his paper, which had been specially prepared at the request of the organizing committee of the Congress, was merely read by Dr. G. Morge, the Chairman of the session, and not discussed. C. W. Sabrosky (USA) presented another general paper on the "Contemporary state of the taxonomy of the

Fig. 4 - A group of orthopterologists at the Congress. Left to right: Dr. B. Nagy (Budapest), Dr. W. Richter (Stuttgart), Miss S. Ogneva-Miksic (Sarayevo), I. Schubert (Austria), G.Ya. Bey-Biyenko, Dr. D.R. Ragge (London), Dr. Morales Agacino (Madrid), Mrs. R. Ragge, Prof. F.E. Zeuner (London), Mrs. R. Roy, R. Roy (Dakar, Senegal), Dr. R. Ebner (Austria), Prof. L. Schopauer (Paris), Dr. J.M. Willemse (Eigelshoven, Holland), Prof. F.N. Pravdin (Moscow). Photograph by Ye.M. Shumakov.

Diptera", dealing with aspects of nomenclature and study methods and techniques. At one session the young Soviet research worker A. Terteryan spoke effectively on the "Ecology of horsefly larvae and pupae in Armenia". In the discussion on the paper by R. E. Hall (Great Britain) "Chironomidae of three limestone streams in southern England" O. S. Zvereva drew attention to the fact that the author had only found a small number of species (50 of the 400 known in Britain) and suggested that this might be due to methodoligical inadequacies.

Subsection 1e (Hymenoptera) held two sessions, at which only 7 of the 11 papers planned in the program were presented. In his paper "Classification of ichneumon flies on the basis of larval attributes" Dr. J. R. T. Short (Scotland) showed that the morphology of the larvae can be used in classifying the group, and that this could be of importance both in the identification of ichneumon flies from their larvae, which is an as yet undeveloped subject, and in biological pest control. Several papers were of a specialist nature. At the suggestion of Dr. J. van der Vecht (Holland) the subsection also discussed the compilation of a world catalogue of the Hymenoptera.

Subsection 1g (Paleontology), in which the majority of the papers came from the USSR, was interesting. B. B. Rodendorf's paper "Paleontological studies in the USSR" was read by Mrs. O. M. Martynova; her own paper was entitled "Permian and Carboniferous Rhaphidioptera". Mrs. Ye. E. Bekker-Migdisova spoke on "Homoptera of the family Archescytinidae as probable ancestors of the aphids". All these papers were based on new extensive discoveries of fossil insects in the USSR. Dr. F. E. Zeuner (Great Britain) presented two papers — "Evolution of Rhopalocera (Lepidoptera)" and "The Triassic insect fauna of South Africa". Dr. J. Kukalova (Dzechoslovakia) presented a considerable amount of material on "New insects from the Czechoslovakian Paleozoic"; some of the forms that she has discovered are similar to the Paleozoic insects of the Kuznets Basin in Siberia. At the end of the session Dr. A. G. Sharov showed an impression of Dasyleptus brongniarti Shar., a representative of the Paleozoic order Monura of the Apterygota, which he discovered.

More papers were presented in section 1 (Taxonomy and paleontology) as a whole than in any other section and more people attended this section. The papers planned and presented were not, however, always sufficiently interesting and informative; many of them dealt with questions that were so partial or small that they were only of interest to a very small number of the delegates. It would clearly be better if papers of this sort were not included in the program, so as not to overload it and to make the work of Congress less strenuous.

Section 2 (Morphology, anatomy and development) held 7 sessions with a program of 39 papers. That the subject matter of many of these papers was interesting can be seen from such titles as "On the existence of a second pair of antennae in insects" (Dr. J. Figg-Hoblyn, USA), "Adaptive evolution in the structure of the egg in ichneumon flies (Dr. W. R. M. Mason, Canada), "Juvenile hormone and morphogenesis" (Dr. V. Novak, Czechoslovakia), "Histological, histochemical and cytological studies of the central nervous system in various insects" (Professor A. Abraham, Hungary), etc. Professor V. Yakhontov also presented a paper entitled "Comments on the significance of the structure of the unpaired oviduct in the fertilization of insect eggs".

Section 3 (Genetics and cytology) met twice and heard 15 papers dealing with aspects of population genetics, sex determination, the use of cytogenetics in taxonomy and other questions.

Section 4 (Geographical distribution and faunal studies) met 8 times and heard some 50 papers, many of which were interesting and informative. Particular mention should be made of Professor C. H. Lindroth's paper (Sweden) "Connections and barriers in the circumpolar distribution of insects", in which a great many facts were presented. He demonstrated that the number (percentage) of circumpolar species in the Northern Hemisphere increases in the higher geographic latitudes and is richest in the arctic and subarctic sectors of Eastern Siberia and Alaska; in the intervening territories the fauna is impoverished, especially in Northern Scandinavia and, in the Western Hemisphere, in Greenland and Labrador. Professor T. H. Hubbell (USA) gave an interesting paper entitled "Endemism and speciation in relation to Pleistocene changes in Florida and the adjacent coastal plain". Here thefeatures of the local landscape and paleogeography created especially favorable conditions for the formation of an unusually large number of endemic forms, some of which are relicts with related forms in the southwestern United States, Mexico and East Asia. The majority of endemic species are groups of very

closely related allopathic species, often of very restricted distribution; the areas of these species are frequently separated by narrow land barriers or by rivers. Other species exist as isolated populations with territorial or local deviations. These phenomena are explained by Pleistocene changes in sea level accompanied by the submersion and upraising of parts of the territory. This paper was a model of the application of paleogeographic data to the problem of speciation. R. G. Pearson's paper (Great Britain) "Late Quaternary insect ecology" dealt with ecological and zoogeographical analysis of the Upper Quaternary beetles of the British Isles. A glacial deposit ascribed (by radioactive analysis) to the 12th millenium BC has a fauna similar to the contemporary fauna of the Murmansk Peninsula and the Arkhangel'sk district; another deposit belonging to the 9th millenium BC has a fauna similar to that of central Scandinavia, while a deposit dating from after the Ice Age has the local contemporary fauna. This is all evidence of the extensive changes in the distribution of species and faunal complexes associated with past climatic changes. A paper by Dr. Z. Kaszab (Hungary) "The geographic distribution of the Meloidae (Coleoptera)" was based on an analysis of the world fauna of this family in conjunction with paleogeographic data and contained interesting information on the features of its distribution and settlement. Extensive factual material accumulated in the course of 20 years of research was presented in Miss Z. Waloff's contribution (Great Britain) "The distribution of Schistocerca gregaria and its spatial and temporal variation". This species of locust is highly mobile and has an extremely extensive area, within which one should distinguish between the breeding zone and the migratory zone; another typical feature of this pest, and one which makes it difficult to control, is that it does not have constant outbreak areas.

Many Soviet entomologists also attended this section. M. S. Gilyarov spoke on "Distribution features of soil insects and other invertebrates in the forest plantations of Eastern Europe" and presented a great deal of factual material. B. V. Dobrovol'skiy spoke on "Zones and foci of greatest damage in the case of phytophagous insects", Prof. A. I. Kurentsov presented a paper on "Relict types in the entomological fauna of the Ussuri region". Other Soviet papers were presented by D. N. Kobakhidze ("The insect fauna of the Georgian SSR"), E. Ya. Ozols ("Features of the ichneumon fauna of Latvia"), Kh. M. Khaberman ("Halophilous and pseudohalophilous beetles of the coastal region of Estonia"), and A. I. Cherepanov ("Ecological groupings of the click beetles of Western Siberia"). A. I. Kurentsov's paper attracted attention because it contained a great deal of material that is little known abroad on the nature of the relict fauna in the Primor'ye. Kh. M. Khaberman reported that 1146 species of Coleoptera are known in the cosastal fauna of Estonia and gave information on the distribution of halophilous beetles and other ecological groups. E. Ya. Ozols reported that the icheneumon fauna of Latvia contains approximately 1250 species, for which we only know the hosts of 171 species (Lepidoptera 49%, Hymenoptera 35%, Coleoptera 13.7%).

A. I. Kurentsov, E. Ya. Ozols and A. I. Cherepanov criticized G. de Lattin's paper (FGR) "The distribution of Siberian faunal elements in the Western Palearctic region" for its formal approach to the concept of the Siberian elements, in which the cological basis was not taken into consideration.

On the whole, and despite a number of narrowly specialist papers, the meetings of this section were lively and interesting. A number of foreign scholars used excellent colored photographs to illustrate their papers. It must be mentioned that many of the achievements of Soviet entomological geography are still unknown abroad.

Section 5 (Behavior and social insects) held 4 sessions at which approximately 20 papers were presented. Prof. V. V. Popov, who attended these meetings, informs me that the papers were very similar in content and quality, that many of them did not deal with the origins of social life in the species being studied and that some of them were highly specialized. Interesting papers were given by Prof. R. D. Alexander of the USA ("Rudimentary social behavior in field crickets") and by Professor K. Gösswald of the FGR ("Studies of mating and adaptational modifications in various species of Formica"). Dr. A. E. Treat (USA) accompanied his paper "Behavioral features of the moth ear mite Myrmonyssus phalaenodectes" by an excellent color film.

There were 66 papers in the program of section 6 (Physiology and experimental ecology), which was one of the most important sections at the Congress. Soviet papers were presented by Dr. G. A. Mazokhin-Porshnyakova ("New information on the mechanism of color vision in insects") and A. B. Getsova ("Desorption of radioactive substances in certain aquatic invertebrates").

Sections 7-14 dealt with applied entomology and related questions. "The protection of plants from pests" was dealt with in sections 7 (Agricultural entomology — more than 50 papers), 8 (Forest entomology — approximately 40 papers), 12 (Control measures and methods — approximately 30 papers) and 13 (Biological control — approximately 75 papers). Consequently some 200 papers dealt with plant protection. They are reviewed in an article by Yakhontov (Zashchita rastenii, No. 1, 1961: 59-62) and in Shumakov's article "Agricultural entomology at the XIth International Entomological Congress in Vienna", which is published below; I shall not therefore deal with the work of these sections, but shall merely note that several Soviet entomologists presented papers to them: V. P. Vasil'yev "Pest control principles in fruit farming", B. V. Dobrovol'skiy "The problem of wireworm control and the way in which it is being solved in the USSR", L. P. Kalandadze and I. D. Batiashvili "Features of the reaction of the corn borer and the cotton-boll worm to changes in conditions obtaining in the Georgian humid subtropics", N. G. Samedov "On the ecological characters of Coleoptera that harm agricultural crops in Azerbaydzhan", G. A. Viktorov "Food specialization of the Phasiinae in relation to the population dynamics of Eurygaster integriceps Put.", A. A. Yevlakhova "The results of experimental studies on increasing the virulence of various entomophage fungi", V. A. Shchepetil'nikova "Increasing the efficacy of entomophages by concentration on honey plants and additional feeding" (not in the published program). I also spoke in section 7 on "Some aspects of the formation of a wheat field fauna when virgin steppe is brought under cultivation."

The other sections of the Congress were: section 9 (Storage pests — more than 10 papers), 10 (Medical and Veterinary entomology — approximately 70 papers), 11 — (Apiculture — approximately 20 papers) and 14 (Conservation — only 2 papers).

The work of the sections, which embraced all branches of theoretical and applied entomology, was the major part of the work of the Congress.

The Work of the Symposia

One aspect of the work of the Congress was the holding of symposia, of which there were seventeen. Some were devoted to individual orders (Ephemeroptera, Odonata and Plecoptera); papers were presented to these symposia by Dr. O. A. Chernova ("The study of the Ephemeroptera in the USSR") and Dr. A. G. Sharov ("The origin and family relationships of the Plecoptera"). One symposium was devoted to the taxonomy of entomophagic insects and another dealt with basic general aspects of taxonomy and nomenclature. Two symposia were devoted to aspects of general and applied study of the Acarina.

There was a separate symposium on soil invertebrates. General aspects were dealt with in papers by Dr. J. Balogh (Hungary) ("Soil zoology in the present and future") and Dr. W. Dunger (GDR) ("Food selectivity of certain soil arthropods from the point of view of biological productivity"), in which the soil-forming activity of insects was dealt with. Dr. A. N. Zrashevskiy spoke (outside the program) on "The relationship between the distribution of beet pest and soil properties". Most of the other papers were of a specialist nature.

Two symposia were devoted to biochemical questions. One "Insect chemistry" lasted for a considerable time and included approximately 50 papers and contributions to the discussion; the other "Chemical defence mechanisms in arthropods" had less than 10 papers. The symposium on "Insect acoustics" was also small.

Professor B. P. Uvarov (Great Britain) took the chair at the large and interesting symposium on "Long range displacements and migration of winged insects". More than 20 papers were presented to the two sessions. These papers dealt with aspects of the movement and migration of the desert locust, Homoptera, Hemiptera, Coleoptera, especially the Coccinellidae, Lepidoptera, Diptera, etc. One Soviet participant, Prof. V. V. Yakhontov, spoke on "Seasonal migrations of Brumus octosignatus Gebl. and Semiadalia undecimnotata Schn. in Soviet Central Asia". The symposium

revealed that long range movements and migrations were very wide-spread among insects and that there were many forms of such movements: this was stressed by the chairman in his summing up; he also stressed that migration and insect movements should be studied both as a biological phenomenon and in relation to applied entomology, i.e., it can be of economic significance.

Three symposia were concerned with aspects of medical and veterinary entomology and the study of the Acarida: "The behavior of blood-sucking mosquitoes in their search for hosts", "Tick-born diseases" and "Arthropoda in relation to blood parasites, especially those of wild animals". One symposium was devoted to the resistance of insect pests to insecticides. Applied aspects were also discussed in the symposium "The economic importance of insects". Finally, there was a symposium on the original theme of "Insect life in cities".

The symposia therefore dealt with a wide range of problems in general and applied entomology and the study of the Acarina.

Film Screenings

The program also included a great many films, which were seen by many delegates. A French film by Dr. P. Vayssiere "The desert locust" was especially interesting. Some of the films were not directly concerned with entomology. Unfortunately there were no Soviet films.

The Vienna Natural History Museum

Vienna is a major center for entomological taxonomy. A number of outstanding taxonomists, who have discovered and described several thousand new species, have worked here. The collections established by these scholars are extremely rich in content and of unique scientific importance. The majority of these collections are housed in the Museum.

Many Congress delegates, including Soviet entomologists, naturally devoted some of their time to work in the Museum, which was visited by many foreign specialists while the Congress was in session.

The Entomological Department and its collections did not suffer any serious damage during the war, and the collections are, in the main, in a satisfactory condition. There is, however, a shortage of scientific staff and attendants.

Thanks to the kindness of Dr. Beier (the Head of the Department), Dr. Fischer and the staff, I and a number of my colleagues were able to examine the collections and to study the type specimens of a number of species. On my own behalf and on behalf of my colleagues I should like to express our sincere gratitude to Dr. Beier and his staff for permission to work in the Museum and for the unfailing assistance given to us at such a busy time.

Meetings at the Congress

One extremely fundamental aspect of our attendance at the Congress was the opportunity that it provided to have personal meetings and make contact with specialists working in the same or closely related fields. It gave us great pleasure to meet colleagues with whom we have been in correspondence for many years or whom we have previously met only briefly. We held friendly discussions with some of these people on special problems and discussed a number of scientific questions.

Many Congress delegates were extremely interested in Soviet entomology and expressed the desire to visit the Soviet Union and stay in Moscow and Leningrad and work in our research establishments. Some foreign scholars suggested that they help to work up our collections and that we should exchange specimens. Many eminent delegates insisted on the desirability of holding one of the next international entomological congresses in the USSR.

The whole atmosphere of the Congress was both friendly and workmanlike.

Conclusions

Our trip to the Congress was interesting, informative and useful. It enabled us to get to know the present state of entomological studies abroad and to make personal contacts with many scholars. It also enabled us to become better acquainted with Austrian entomologists and scientific establishments. It confirmed our belief that at is present stage entomology can and should play and important part in increasing output in agriculture and forestry, in safeguarding human health and in the general development of the community.

AGRICULTURAL ENTOMOLOGY AT THE ELEVENTH ENTOMOLOGICAL CONGRESS, VIENNA

YE. M. SHUMAKOV

International entomological congresses are held once every four or five years. The first, held in Brussels (Belgium) in 1910, was attended by 150 people; at the Eleventh (Vienna, 1960) attendance had risen to 1800. The increased attendance at congresses, the great progress achieved in research organization and in methods of studying insects and the appearance of an immense entomological literature reflect the growing practical importance of entomology in the economic and cultural life of many countries.

The fourteen sections of the Eleventh International Entomological Congress represented the main branches of the science of entomology. At the Section on agricultural entomology some fifty-five papers were read. These papers, however, fell far short of exhausting all the aspects of plant protection from pests, discussed at the congress. In particular, all problems connected with chemical and biological methods of pest control were discussed in separate Sections. There were also several Symposia on questions of agricultural entomology. Of the 850-900 papers read at all the Sections and Symposia, not less than half were devoted to agricultural and forest entomology.

There were two main problems discussed at the Section on agricultural entomology: 1) the study of agricultural biocoenoses, 2) crop immunity to harmful insects.

A paper by G. Ya. Bey-Biyenko (USSR), "Some peculiarities in the formation of wheat pest fauna in connection with the reclamation of virgin lands", was a significant contribution to the discussion of agricultural biocoenoses. The author reported the results of pre-war research in the Orenburg province of the Soviet Union, when the process of insect fauna modification due to the plowing up of virgin steppelands had been investigated. It had been shown that the original fauna was almost completely replaced by new species. Those species which had previously dominated disappeared almost completely, to be replaced by a small number of new species, which subsequently increased to very large populations. The Congress showed great interest in this paper, since it revealed a new rapidly developing trend in the USSR, whereby agricultural entomology is becoming bound up with the study of biocenotic developments caused by man's productive activity. Speaking on this paper, the President of the London Entomological Society, B. P. Uvarov, stressed the novelty of this trend and indicated its importance as a most interesting line of development in ecological research directed to the faunal and ecological study of regions with an arid (desert steppe) climate.

Other contributors also gave the Congress new information on similar investigations of crop biocoenoses. Skugravá and Novak (Czechoslovakia), for example, gave data on the composition of the insect fauna infesting potato, clover and sugar-beet fields in Czechoslovakia. They have made a special point of studying the interrelationships among the fauna of various crops and, in particular, the role of predaceous beetles (Carabidae) and had studied the diet of these insects by analysis of the intestinal contents.

In another paper the same two authors reported on the effect of chemical methods of Colorado beetle control on the insect fauna of potato fields. Such methods cause very violent disturbances in the biocoenosis, but since comparatively small areas are treated in Colorado beetle control the status quo is restored fairly quickly through the migration of insects from neighboring untreated fields.

A number of papers was devoted to problems of immunity. K. H. Painter (USA) reported on the achievements of American scientists in studying the resistance of agricultural crops to insect pests. Nine varieties of wheat resistant to Hessian fly are grown in the USA. In the northern states of the USA and in Canada several million acres are sown to two varieties of spring wheat and one variety of winter wheat which are resistant to the Hessian fly. There are varieties of maise (Indian corn) which are resistant to the corn borer and varieties of lucerne immune from aphids. In recent years the resistance of twenty grain crops to fifty-two species of insect pests has been studied.

E. Norber (Switzerland) read a paper on pest-resistant field crops.

Other papers read at the Section on agricultural entomology included one by B. V. Dobrovol'skiy (Moscow), on Soviet methods of click beetle control and one by V. P. Vasil'yev (Kiev) on the principles of fruit pest control. A number of other papers by entomologists from the Soviet Union and the Peoples' Democracies were also read.

The Section on storehouse pests was divided into two subsections. At the subsection on storehouse pests several of the papers presented dealt with the new preparations for fumigating storage sheds and their contents and with the situation in regard to storage pest control in Yugoslavia, Italy and Turkey. The subsection on root pests heard three papers on death watch beetles (Anobiidae) and their control in Britain, the USA and the Federal Republic of Germany as well as a communication from J. D. Blatchly and J. M. Taylor (United Kingdom) on methods of testing preparations used for disinfecting wood.

The work of the Section included visits to storehouses and silos in order that participants might get an idea of the large scale storage facilities for agricultural products available in Austria.

The meetings of the Section on pest control and apparatus attracted a very large audience. The main papers here dealt with new insecticides, the use of radioactive isotopes in the study of insect toxicology, methods of toxological research and so forth.

T. G. Raley (USA) reported on the organization of mosquito control in the USA, where special steps were being taken to eliminate mosquitoes from fifty-four areas. The methods chiefly used were the spraying of water bodies with petroleum oils and the application of organophosphorous insecticides. A visit to Krems was arranged for the participants.

The largest Section was that on biological methods of pest control. This was divided into three subsections, in which seventy-five papers were presented. The plenary meeting of this section heard a number of informative reports on the work of the International Commission on Biological Control (Commission internationale pour la lutte biologique), which has its headquarters in Paris and is run mainly by French entomologists. This organization has an extensive program of experimental work in various countries throughout the world, organizes the international exchange of entomophages and issues its own journal, "Entomophaga."

Reports on trends in the work of the above-mentioned body were made by a number of people (A. S. Balachowski, P. Grison, G. Remandière, France; J. Franz, Darmstadt, Federal Republic of Germany). At the same meeting reports on biological pest control in the USA, Venezuela and the Middle East were presented.

The Section held a symposium on biological methods of Colorado beetle control. Representatives of the USSR, the German Democratic Republic, Czechoslovakia, Hungary, France, Belgium, the Netherlands and the Federal Republic of Germany learned, in informal discussion, of work on the acclimatization of the predacious Perillus and the tachina fly Doryphorophaga in those countries.

Representatives of the USSR (V. P. Vasil'yev and V. A. Shchepetil'nikova) reported that Beaveria bassiana had been successfully used against Colorado beetle in the Western Ukraine.

A series of reports dealing with the patterns of entomophage-host interrelationships and factors determining the effectiveness of entomophages were presented by American entomologists at the subsection on predacious and parasitic insects (Flanders, De Bach, Holloway, Hoffman). In these papers special attention was paid to the capacity of entomophages to seek out their own hosts. This was regarded as an important index of their effectiveness. A paper by J. Franz (Federal Republic of Germany) dealt with biological control terminology. The author considered that the term "biological control" should be restricted in meaning to the use of entomophages under active human control. Strong objections were raised against the expression "live insecticide". V. A. Shchepetil'nikova (Leningrad) read a paper on methods of concentrating the entomophages in nectariferous plants and on the study of supplementary feeding of the imaginal stage and the migrations of parasitic insects connected with this.

At the subsection on virus insect diseases papers were read by K. Maramorosch and S. Buckley (USA) on successful cultivation of arthropod and warm-blooded animal tissues and on the state of insect tissue culture. This method made it possible to use a tissue culture instead of experimental animals.

Papers by K. M. Smith and G. Hells (United Kingdom) and E. Jahn (Austria) dealt with the study of polyhedral virus structure. Physiological data on the multiplication of the polyhedral virus and on its latency formed the subject of a paper by S. Gerzhenzon (Kiev). A number of papers contained information on the effect of certain plant viruses on insects and of insect viruses on plants, and on insect virus epizooties.

A third subsection discussed the use of other pathogenic microorganisms (fungi, bacteria and Protozoa) as agents for purposes of biological pest control. A communication on the work of the International Biological Control Commission (C. I. L. B.) was read by P. Grison (France), and A. A. Yevlakova (Leningrad) reported on the results of experiments in enhancing the virulence of fungi pathogenic to insects. L. Marshall (Canada) reported on microbiological control of mosquitoes of the genus Aedes. J. Weiser (Czechoslovakia) read a paper on the use of Nematoda in pest control.

An important topic at the Congress was the locust problem, various aspects of which were dealt with at the Section meetings and Symposia by a score of entomologists from different countries. In the insect taxonomy Section six papers were devoted to the systematics of different groups of locusts. A paper which had been expected from Dirsch (United Kingdom), on a new classification of locusts, was not given, but the basic ideas underlying this paper, which was the joint work of Dirsch and Uvarov, are well known from these authors' recently published works.

Special interest attached to a paper prepared by the head of the geographical section of the Anti-locust Research Center in London, Z. Waloff (United Kingdom) on the spatial and temporal distribution patterns of the desert locust (Schistocerca), in which the author reported the results of the London Center's twenty years of research on Schistocerca migration and reproduction patterns.

It has proved impossible to discover definite breeding sites of Schistocerca, where preventive control could be organized as in the case of other species of gregarious locusts. Breeding sites appear from time to time now at one end, now at another, of an immense area covering Africa, South Asia and part of Southern Europe. The total area subject to invasion by locust swarms amount to 30 million square kilometers and cover sixty-one countries.

On the basis of material collected by the London Center an analysis had been made of the breeding patterns of locusts. The breeding zone was smaller than the zone subject to invasion and consisted of about 13 million square kilometers or roughly 46% of the invasion zone. The breeding of the desert locust was closely connected with the seasonal classificiation pattern.

The vast area of Schistocerca occurrence made up a single whole, of which all the parts were closely interconnected. The control problem was therefore in fact an international one which could not be solved by any one country alone.

Despite the existence of two international centers (the FAO Commission on Schistocerca control attached to the United Nations and the Anti-locust Research Center in London) international cooperation in this field left much to be desired. So far there had been very little real practical advance towards creating a centralized international organization for Schistocerca control.

Study of the seasonal variations in the breeding habits of Schistocerca had shown that the third quarter of the year (particularly August and September) accounted for most of the breeding. The swarm zone was then at its smallest and almost coincided with that in which the nymphs emerged. The London center proposed a new control strategy, based on taking advantage of this peculiarity in the breeding habits of the locust. Whether that proposal could be put into effect or not would depend exclusively on how far international cooperation could be organized for the purpose.

During the last decade, locust breeding had been highest in 1954 and 1959, lowest in 1949 and 1952. This meant that the world situation in regard to Schistocerca created in the last few years was extremely serious and that there was a very real threat of invasions of the Soviet Union by locust swarms, since the immense scale of locust breeding in Africa, and particularly in Arabia, had been very little counteracted by active extermination measures.

At the same Symposium on insect migration a paper was read by Dr. R. C. Rainey of the London Anti-Locust Center, on the mechanism of desert locust swarming and of the migration of other insects. Dr. Rainey reported on the results of observations over periods of many days on a hundred individual locust swarms and emphasized that the locust flights were seasonal displacements of populations rather than "destination" migrations as in the case of other insects.

Many papers on locusts were read at the Section on physiology and experimental ecology. Z. Waloff reported on the pattern of fat reserve losses in Schistocerca during prolonged migrations and showed that observations under field conditions had corroborated the results of laboratory experiments. The fat was the main source of energy during the flight period. Other papers read at this Section dealt with metabolism and diapause in the most injurious gregarious species.

No provision had been made on the Congress agenda for a Symposium on the economic importance of pests, but in view of the urgent necessity for a discussion of the most general and fundamental questions of plant protection a number of entomologists requested that the Eleventh International Entomological Congress be made the occasion for such a discussion. The initiative for organizing a symposium on this theme was taken by entomologists from the Rothampsted Experimental Station (United Kingdom). On behalf of the Congress organizers they asked organizations in a number of countries, including the Soviet All-Union Institute of Plant Protection, to contribute to the Symposium, with a view to discussing methods of streamlining pest control. Only four countries took part in the Symposium—the USSR, the United Kingdom, the United States of America and Canada. As research and work on plant protection in those countries is on a very large scale thepapers presented at the Symposium were of great importance. Eleven papers altogether were read, under three heads: preventive entomology, local problems and streamlined control planning.

The first group of papers was introduced by A. H. Strickland (United Kingdom) with a contribution on the size of insect populations requiring control measures. The author's general view was that pest control measures should be commensurate in cost with the increased production obtained as a result of those measures. The use of conventional insecticides was increasing throughout the world; but it seemed essential to restrict their application to cases where the value of the control measures was greater than the potential losses. The basis for working out effective systems of prophylactic measures must be an understanding of the interconnection between the pest population and the crop yield.

The author supported these general views with examples concerning fruit fly control in England.

The second group of papers dealt with aspects of plant protection in tropical Africa, Canada and the United Kingdom. The data adduced illustrated the modern approach to problems of pest control and their practical agricultural significance.

The final meeting of this Symposium was the most interesting. Five papers were read, dealing with the most general problems of organizing plant protection in three countries—the USSR, the USA and Canada. D. N. Burgess (USA) dealt with "Agricultural entomology in the USA". This paper was concerned with rather special problems, since at the preceding International Entomological Congress (Montreal, Canada, 1956) the American entomologists had presented a large number of papers on various ways in which plant protection was organized in the USA.

B. N. Smallman (Canada) reported on the main trends in agricultural entomology in Canada, dealing primarily with the work of the plant protection research unit of the Department of Agriculture and methods of planning and organizing scientific work in this field. Interesting facts were given on the development of new trends in pest control in Canada; the special characteristics of these trends lay in the contrast they offered to the chemical method of control and they were of major interest as new fields of research.

One such trend was the use of polybutenes against phytophagous mites. This method had been invented at the Institute of Pesticides in London (Ontario, Canada) and at the Vineland station of the Canadian Department of Agriculture. The polybutene preparation used for mite control was Indopol H-1500. This is a very sticky and viscous liquid, insoluble in water. A 50% emulsion was prepared by adding 1.5% of any emulsifier; for spraying, a 5% emulsion was prepared. After the mite-infested leaf had been sprayed the polybutenes settled on the pubescence in the form of small droplets, making the surface of the leaf sticky. The mobile forms of mites, crawling of these droplets, would adhere to them and perish. Polybutenes were quite harmless to plants and di not burn even young leaves. The substances were not toxic and their use was based on their physical properties.

Other new trends in research included work on gamma-ray sterilization of male insects. That method of pest control had been studied in the USA since 1950 and was now being developed in Canada as a control measure against the most important orchard pest, the codling moth. Insects irradiated with a certain dose of gamma-rays were proved sterile. Irradiated females laid no eggs after copulating with non-irradiated males, but if irradiated males copulated with non-irradiated females the latter did lay eggs, but these yielded no larvae. That was the feature of practical value, since irradiated males could be released into nature. The prerequisite for putting the method into practice was, of course, that an economical technique should be worked out for the mass production of the pest for irradiation in the laboratory and subsequent release. In the USA practical success had been achieved in that field in Calitroga control in the south-eastern states.

Ye. M. Shumakov (Leningrad) contributed the symposium paper on the tactics of pest control in the USSR. The symposium also contained two other papers, one on "Forest entomology in the USA' (W. V. Benedict) and one on "Forest entomology in Canada (B. N. Smallman). An ad hoc symposium on soil invertebrates was also held. Eleven papers were read, the main one being a report by the eminent Hungarian scientist J. Balogh, on "The present and future of soil zoology." The author emphasized the growing importance of studying soil invertebrates in view of their enormous role in soil formation and in creating soil fertility. It was particularly important that the most numerous soil arthropods were good biological indicators. Biotopic differences which passed unnoticed when other methods of investigation were used could be revealed when the composition of the soil fauna was examined.

Almost 90% of the experts on soil zoology and a corresponding number of the relevant scientific institutions were in Europe and the United States of America, although those two areas made up roughly only 20% of the earth's surface. The soil animals of the remaining 80% of the globe had been very little studied and the speaker therefore urged that priority be given to studying the soil fauna composition in regions that had been little investigated, and to work on the difficult questions of soil-animal taxonomy as well as to the study of the faunal composition of various soil groups and the role of particular groups of organisms in the soil-forming process.

Dr. D. K. Kevan (Canada) read a paper on the study of soil invertebrates in Canada. A paper by Dr. J. B. Kring (USA), on methods of studying the feeding habits of click beetles and rearing them under laboratory conditions was of interest. An original methodological procedure was being used for rearing these insects in test tubes with wet filter paper, so that their life and feeding habits could be directly observed.

Methods of international cooperation in soil zoology were discussed at the symposium. It was resolved to issue an international journal, under the title "Soil Biology." A brief account of this new periodical was recently published in the "Zoologicheskiy Zhurnal" 39 (10), 1960.

The last day of the Congress was spent on an excursion to Langeleuss near Krems, where delegates were shown up-to-date apparatus used in Lower Austria for pest control. Twenty-two types of machines, produced by various Austrian and West German firms, and including manual, horse-drawn and tractor-drawn types, were demonstrated.

In summing up the work of the Eleventh International Entomological Congress, one should note not only the high proportion of papers on questions of agricultural entomology, but also the practical trend of much research on questions of general entomology. Topics connected with agricultural entomology were discussed in almost all the Sections and Symposia.

At the Section on Physiology and Experimental Ecology, for example, an interesting paper was read by the young British entomologist T. R. E. Southwood, on the evolution of interrelationships between insects and plant hosts. The author showed that the commonest species of trees had a richer pest fauna than the rarer species. He stressed the important part played by plant alkaloids as a factor determining the suitability of a given species of plant as a food for certain species of insects.

In the same Section, as well as at the Symposium on insect biochemistry, many papers on the trophisms of injurious insects were read; this is a problem of great theoretical importance for agricultural entomology.

At the Section on Geographical Distribution and Faunistics, as well as at the Symposium on Insect Migration, many questions related to the study of the distribution of insect pests and entomophages were discussed.

The taxonomy of many economically important groups of harmful insects (mites), scales, locusts, long-horned beetles, leafrollers, butterflies, parasitic Hymenoptera and so forth, were the subject of papers at the Section on Systematics and Palaeontology.

The interpenetration of general, theoretical and applied problems is a characteristic feature of the whole development of modern entomology.

REVIEWS AND BIBLIOGRAPHY

BUMBLEBEES

by J.B. FREE AND C.G. BUTLER

Collins, London: 13 +208, 25 +3 fig. 1959.

D. M. SHTEYNBERG

There has long been a pressing need for a generalized account of the biology of bumblebees. The job has now been done by John Free, a young expert in this field who is on the scientific staff of the Rothamsted Experimental Station, in collaboration with Colin Butler, Director of the Beekeeping Department at Rothamsted. The book has appeared as one of a series entitled "The New Naturalist", in which thirty-nine volumes have already been published. The series aims at acquainting a wide public, at up-to-date, scientific level, both with the biology of particular groups of plants and animals and with their life habits in associations in a variety of natural topographical conditions.

Since 1912, when the first large research monograph on bumblebee biology was published in England (Sladen, 1912) only one summary specifically concerned with this group of bees has appeared (Plath, Bumblebees and their ways, New York, 1934) and this is now largely out of date. Meanwhile, a fairly considerable number of research papers on various aspects of the vital activity of bumblebees has appeared of late, some of them mutually contradictory, including work by Free. A general summary had therefore become necessary and one cannot but welcome the undertaking of this by no means easy task by Free and Butler.

The book consists of sixteen main chapters: introduction, the foundation of the colony, the growth of the colony, the maturity and break-up of the colony, males and young females, the division of labor within the colony, laying workers, recognition of friends and enemies, cuckoo bees, foraging, bumblebees and flowers, locality memory, the economic importance of bumblebees, and the affinities of bumblebees. There are also four chapters by way of appendix, two on methods of collecting and studying bumblebees and on rearing them under experimental conditions and two, by J. H. H. Yarrow, on the taxonomy and distribution of British bumblebees.

The early chapters, on the foundation and development of the bumblebee family, make highly interesting reading. The authors' reason for invariably using the term "colony", however, is obscure, for they are dealing with a family consisting of members which develop from eggs laid by a single female. Discussing in detail the structure of the barrel-shaped hatching chambers, their distribution within the nest, differences in female behavior during the foundation of the nest and during its growth and differences in the type of feeding of the young connected with the arrangement of the chambers, the authors keep to Sladen's terminology and divide all bumblebees into two groups: the "pollen-storers" and the "pocket-makers" for this purpose. The former accumulate pollen in tall wax cylinders in the center of the next and feed the larvae steadily from these (Bombus lucorum, B. terrestris and others). The second group fill with pollen special wax pockets arranged round the periphery of the nest; the young larvae feed themselves from these, to a large extent independently, and are only sporadically fed by the workers (B. agrorum, B. hortorum and others).

In discussing the reasons for the development of females during the second half of the family's existence the authors conclude that the decisive factor is the amount of food obtained by the larvae. The number of workers relative to the number of larvae steadily increases, with the result that the larvae obtain a steadily increasing amount of food; this in turn leads to a development of females. If one artificially increases the number of workers one can obtain females even from the first oviposition under experimental conditions. The authors deny the importance of qualitative differences in the food obtained by worker larvae and female larvae (it has been precisely established that in honey bees such differences are appreciable). Morphological differences between females and workers correlate less significantly with merely qualitative differences in food in the pocket-building species, where the larvae feed more independently, than in cylinder-building species, where they are fed exclusively with worker assistance.

The book contains many interesting details on the behavior of young males and females before mating, on substances attracting the male and on the flight patterns, specific to each species, of males in search of females. The authors believe that in certain cases the males try to mate with workers as well, but that, since these cannot be fertilized, the facultative ovipositions of workers (which have long been known) invariably contain only unfertilized eggs, which develop only into males.

Discussing the complicated question of why cuckoo bees of the genus Psithyrus occur, the authors conclude that there is evidence both to support the theory that various species of this genus developed from a single common stock and for a much simpler explanation, based on the concept of a polyphyletic origin of this genus from various species of existing bumblebees. There is also a discussion of facultative predaceousness which is fairly common in certain species of Bombus. It is a pity that the authors did not know of the interesting observations reported by G. S. Voveykov (Entom. obozr. 33, 1953) on the pattern of recurrent predaceousness in certain species of existing bumblebees, which can even have a positive influence on the population growth of the family if there is an alternation of females within a single species.

There is a detailed discussion of the relationships between bumblebees and flowering plants, the division of functions among foraging workers and those concerned with feeding the young and on the correlation between the size of worker bees (large and small) and their fulfillment of various functions. The authors conclude that bumblebees individually accustomed to certain species of flowering plants are incapable of directing other bumblebees to the same species; the well-known honey bee "dances" orientating the flight in search of nectar in a definite direction, do not exist in bumblebees, and so the individual cannot communicate its experience to the family.

The appendix chapters contain valuable methodological instructions on rearing various species of bumblebees under laboratory conditions and on the technique of observing their behavior.

The book is simply written and perfectly intelligible to the layman, although the style of exposition and the discussion are always strictly scientific and objective. A major defect of the book is its total neglect of the Russian literature. The only pre-war Russian paper cited is that of Kurochkin (1930) and not a single post-war paper is mentioned. The existence of works by A. F. Gubin, A. S. Skorikov, A. N. Mel'nichenko, V. V. Popov, G. S. Voveykov, D. V. Panfilov and other Soviet scientists on various aspects of the morphology, systematics, biology and pollinating activity of bumblebees cannot possibly have been unknown to the authors and they could certainly have had them translated into English. While regretting that they did not do this we would ask them to include material gathered by Soviet scientists who have studied bumblebee biology when they come to prepare a new edition of their interesting book.

JOURNAL OF INSECT PATHOLOGY

Managing Editor, Edward A. Steinhaus. Academic Press. New York and London.

D. M. SHTEYNBERG

The first issue of a new journal, the Journal of Insect Pathology, came out in May 1959, under the editorship of Edward A. Steinhaus. The first volume (Nos. 1-4) and Nos. 1 and 2 of the second volume (1960) have already been published. The journal aims at publishing original papers on insect diseases, the morphology, physiology and life cycles of pathogenic fungi, bacteria, viruses and unicellular animals infesting insects and advances in microbiological pest control methods. The editorial board is made up of eminent scientists working on insect microbiology in Czechoslovakia, the USA, Canada, Britain, the Federal Republic of Germany, France and Japan.

The first volume contains many papers of considerable interest. Bergold and Suter, for example, have provided a number of excellent electron microscope photographs of the cytoplasmic polyhedra of butterfly caterpillars; Kramer discusses the interrelationships between Perezia pyraustae (Sporozoa, Nosematidae) and its host, the corn borer; Huger has studied the nature of crystalline inclusions observed in Tipula rickettsial disease; McEwen and Hervey experimented with the use of Bacillus thuringiensis and Bergoldia virulenta preparations against Pieris rapae L. and Trichoplusia ni L. in the New York neighborhood; Stern, Hall and Peterson write on the control of alfalfa caterpillars in California and Abul-Nasr on a test application of polyhedral virus against Prodenia litura in Egypt; Chao and Wistreich describe the bacterial flora of the middle intestine of Culex, and Bucher and Stephens describe various bacteria extracted from long-horned grasshoppers in Canada; Gabriel investigated the possibility of insect infection by fungus through the alimentary tract. Mains provides a valuable review of fungi of the genus Aschersonia. A number of new descriptions of coccids, fungi, microsporidia and viruses is included, along with other taxonomic work. The first volume contains 443 pages, 39 papers and 9 short communications.

The appearance of anew international journal will undoubtedly help the development of this comparatively new field, insect microbiology and pathology. The papers published from various countries are evidence of the rapid growth of this subject both as regards the ever increasing number of new subjects of investigation and in the direction of more thorough study of their morphology, physiology and pathogenesis.

One can only regret that insect pathology is still so inadequately studied in the Soviet Union. The dearth of papers on these subjects on the editorial desk of the present journal (Entom. obozr.) is a reflection of this situation.

RUSSIAN JOURNALS FREQUENTLY CITED

[Biological Sciences]

Abbreviation[1]	Journal[1]	Translation
Agrobiol.	Agrobiologiya	Agrobiology
Akusherstvo i Ginekol.	Akusherstvo i Ginekologiya	Obstetrics and Gynecology
Antibiotiki	Antibiotiki	Antibiotics
Aptechnoye Delo	Aptechnoye Delo	Pharmaceutical Transactions
Arkh. Anat. Gistol. i. Embriol.	Arkhiv Anatomii Gistologii i Embriologii	Archives of Anatomy, Histology, and Embryology
Arkh. Biol. Nauk SSSR	Arkhiv Biologicheskikh Nauk SSSR	Archives of Biological Science USSR
Arkh. Patol.	Arkhiv Patologii	Archives of Pathology
Biofizika	Biofizika	Biophysics
Biokhimiya	Biokhimiya	Biochemistry
Biokhim. Plovod i Ovoshchey	Biokhimiya Plovod i Ovoshchey	Biochemistry of Fruits and Vegetables
Bot. Zhur.	Botanicheskiy Zhurnal	Journal of Botany
Byull. Eksptl. Biol. i Med.	Byulleten' Eksperimentalnóy Biologii i Meditsiny	Bulletin of Experimental Biology and Medicine
Byull. Moskov. Obshchestva Ispytateley Prirody, Otdel Biol.	Byulleten' Moskovskogo Obshchestva Ispytateley Prirody, Otdel Biologicheskiy	Bulletin of the Moscow Naturalists Society, Division of Biology
Doklady Akad. Nauk SSSR	Doklady Akademii Nauk SSSR	Proceedings of the Academy of Sciences USSR
Eksptl. Khirurg.	Eksperimentalnaya Khirurgiya	Experimental Surgery
Farmakol. i Toksikol.	Farmakologiya i Toksikologiya	Pharmacology and Toxicology
Farmatsiya	Farmatsiya	Pharmacy
Fiziol. Rasteniy	Fiziologiya Rasteniy	Plant Physiology
Fiziol. Zhur. SSSR	Fiziologicheskiy Zhurnal SSSR im. I. M. Sechenova	I. M. Sechenov Physiology Journal USSR
Gigiyena i Sanit.	Gigiyena i Sanitariya	Hygience and Sanitation
Izvest. Akad. Nauk SSSR, Ser. Biol.	Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya	Bulletin of the Academy of Sciences USSR, Biology Series
Izvest. Tikhookeanskogo N. I. Inst. Rybnogo Khoz. i Okeanog.	Izvestiya Tikhookeanskogo N. I. Instituta Rybnogo Khozyaystva i Okeanografii	Bulletin of the Pacific Ocean Scientific Institute of Fisheries and Oceanography
Khirurgiya	Khirurgiya	Surgery
Klin. Med.	Klinicheskaya Meditsina	Clinical Medicine
Lab. Delo	Laboratornoye Delo (po Voprosam Meditsiny)	Laboratory Work (on Medical Problems)
Med. Parazitol.	Meditsinskaya Parazitologiya i Parazitarnye Bolezni	Medical Parasitology and Parasitic Diseases
Med. Radiol.	Meditsinskaya Radiologiya	Medical Radiology
Med. Zhur. Ukrain.	Medichniy Zhurnal Ukrainskiy	Ukrainian Medical Journal
Mikrobiologiya	Mikrobiologiya	Microbiology
Mikrobiol. Zhur.	Mikrobiologichniy Zhurnal	Microbiology Journal
Nevropatol. Psikhiat. i Psikhogig.	Nevropatologiya, Psikhiatriya i Psikhogigiyena	Neuropathology, Psychiatry and Psychohygiene
Ortoped., Travmatol. i Protez.	Ortopediya, Travmatologiya i Protezirovaniye	Orthopedics, Traumatology and Prosthetics
Parazitol. Sbornik	Parazitologicheskiy Sbornik	Parasitology Collection
Pediatriya	Pediatriya	Pediatrics
Pochvovedeniye	Pochvovedeniye	Soil Science
Priroda	Priroda	Nature
Problemy Endokrinol. i Gormonoterap.	Problemy Endokrinologii I Gormonoterapii	Problems of Endocrinology and Hormone Therapy
Problemy Gematol.	Problemy Gematologii i Perelivaniya Krovi	Problems of Hematology and Blood Transfusion
Problemy Tuberk.	Prolemy Tuberkuleza	Problems of Tuberculosis

[1] Board of Geographic Names Transliteration System.

Sovet. Med.	Sovetskaya Meditsina	Soviet Medicine
Sovet. Vrachebnyy Zhur.	Sovetskiy Vrachebnyy Zhurnal	Soviet Physicians Journals
Stomatologiya	Stomatologiya	Stomatology
Terap. Arkh.	Terapevticheskiy Arkhiv	Therapeutic Archives
Trudy Gelmint. Lab.	Trudy Gelmintologicheskoy Laboratoriya	Transactions of the Helminthology Laboratory
Trudy Inst. Genet.	Trudy Instituta Genetiki	Transactions of the Institute of Genetics
Trudy Inst. Gidrobiol.	Trudy Instituta Gidrobiologiya	Transactions of the Institute of Hydrobiology
Trudy Inst. Mikrobiol.	Trudy Instituta Mikrobiologiya	Transactions of the Institute of Microbiology
Trudy Inst. Okean.	Trudy Instituta Okeanologii. Akademii Nauk SSSR	Transactions of the Institute of Oceanology, Academy of Sciences, USSR
Trudy Leningrad. Obshchestva Yestestvoisp.	Trudy Leningradskogo Obshchestva Yestestvoispytateley	Transactions of the Leningrad Society of Naturalists
Trudy Vsesoyuz. Gidrobiol. Obshchestva	Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva	Transactions of the All-Union Hydrobiological Society
Trudy Vsesoyuz. Inst. Eksptl. Med.	Trudy Vsesoyuznogo Instituta Eksperimental'noy Meditsiny	Transactions of the All-Union Institute of Experimental Medicine
Ukrain. Biokhim. Zhur.	Ukrainskiy Biokhimichniy Zhurnal	Ukrainian Biochemical Journal
Urologiya	Urologiya	Urology
Uspekhi Biokhimii	Uspekhi Biokhimii	Progress in Biochemistry
Uspekhi Sovremennoy Biol.	Uspekhi Sovremennoy Biologii	Progress in Contemporary Biology
Vestnik Akad. Med. Nauk SSSR	Vestnik Akademii Meditsinskikh Nauk SSSR	Bulletin of the Academy of Medical Science, USSR
Vestnik Khirurg. im. Grekova	Vestnik Khirurgii imeni Grekova	Grekov Bulletin of Surgery
Vestnik Leningrad. Univ. Ser. Biol.	Vestnik Leningradskogo Universiteta, Seriya Biologii.	Journal of the Leningrad University, Biology Series
Vestnik Moskov. Univ., Ser. Biol. i Pochvov.	Vestnik Moskovskogo Universiteta, Seriya Biologii i Pochvovedeniya	Bulletin of the Moscow University, Biology and Soil Science Series
Vestnik Oftalmol.	Vestnik Oftalmologii	Bulletin of Ophthalmology
Vestnik Oto-rino-laringol.	Vestnik Oto-rino-laringologii	Bulletin of Otorhinolaryngology
Vestnik Rentgenol. i Radiol.	Vestnik Rentgenologii i Radiologii	Bulletin of Roentgenology and Radiology
Vestnik Venerol. i Dermatol.	Vestnik Venerologii i Dermatologii	Bulletin of Venereology and Dermatology
Veterinariya	Veterinariya	Veterinary Science
Vinodeliye i Vinogradarstvo	Vinodeliye i Vinogradarstvo SSSR	Wine-Making and Viticulture
Voprosy Klin.	Voprosy Klinicheskiye	Clinical Problems
Voprosy Med. Khim.	Voprosy Meditsinskoy Khimii	Problems of Medical Chemistry
Voprosy Med. Virusol.	Voprosy Meditsinskoy Virusologii	Problems of Medical Virology
Voprosy Nevrokhirurg.	Voprosy Nevrokhirugii	Problems of Neurosurgery
Voprosy Onkol.	Voprosy Onkologii	Problems of Oncology
Voprosy Pitaniya	Voprosy Pitaniya	Problems of Nutrition
Voprosy Psikhologii	Voprosy Psikhologii	Problems of Psychology
Voprosy Virusologii	Voprosy Virusologii	Problems of Virology
Vrachebnoye Delo	Vrachebnoye Delo	Medical Profession
Zav. Lab.	Zavodskaya Laboratoriya	Factory Laboratory
Zhur. Mikrobiol., Epidemiol. i Immunobiol.	Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii	Journal of Microbiology, Epidemiology, and Immunobiology
Zhur. Nevropatol. i Psikhiat.	Zhurnal Nevropatologii i Psikhiatrii imeni S. S. Korsakova	S. S. Korsakov Journal of Neuropathology and Psychiatry
Zhur. Obshchey Biol.	Zhurnal Obshchey Biologii	Journal of General Biology
Zhur. Vysshey Nerv. Deyatel.	Zhurnal Vysshey Nervnoy Deyatel'nosti imeni I. P. Pavlova	I. P. Pavlov Journal of Higher Nervous Activity
Zool. Zhur.	Zoologicheskiy Zhurnal	Journal of Zoology

ERRATA

In the article by K. A. Breyev, entitled "Biological Principles of the Control of Warble-Flies, on page 36, Volume 40, Issue Number 1 of ENTOMOLOGICHESKOYE OBOZRENIYE, the following correction should be made.

Reads: "order of 450, 000 rubles annually"

Should read: "order of 450, 000, 000 new rubles annually"

ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN RUSSIAN BIO-SCIENCES LITERATURE

Abbreviation (Transliterated)	Significance
AMN SSSR	Academy of Medical Sciences, USSR
AN SSSR	Academy of Sciences, USSR
BIN	Botanical Institute
FTI	Institute of Physiotherapy
GONTI	State Scientific Technical Institute
GOST	All-Union State Standards
GRRRI	State Roentgenology, Radiology, and Cancer Institute
GTTI	State Technical and Theoretical Literature Press
GU	State University
I Kh N	Scientific Research Institute of Surgical Neuropathology
IL (IIL)	Foreign Literature Press
IONKh	Inst. Gen. and Inorganic Chemistry (N. S. Kurnakov)
IP	Soil Science Institute (Academy of Sciences, USSR)
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd.	Press
LEM	Laboratory for experimental morphogenesis
LENDVI	Leningrad Institute of Dermatology and Venereology
LEO	Laboratory of Experimental Zoology
LIKhT	Leningrad Surgical Institute for Tuberculosis and Bone and Joint Diseases
LIPZ	Leningrad Institute for Study of Occupational Diseases
LIPK	Leningrad Blood Transfusion Institute
Medgiz	State Medical Literature Press
MOPISh	Moscow Society of Apiculture and Sericulture
MVI	Moscow Veterinary Institute
MZdrav	Ministry of Health
MZI	Moscow Zootechnical Institute
LOKhO	Leningrad Society of Orthopedic Surgeons
NIIZ	Scientific Research Institute of Zoology
NINKhI	Scientific Research Institute of Neurosurgery
NIU	Scientific Institute for Fertilizers
NIUIF	Scientific Research Institute of Fertilizers and Insecticides
NIVI	Veterinary Scientific Research Institute
ONTI	Division of the Scientific Technical Press
OTI	Division of Technical Information
RBO	Russian Botanical Society
ROP	Russian Society of Pathologists
SANIIRI	Central Asia Scientific Research Institute of Irrigation
SANIISh	Central Asia Scientific Research Institute of Sericulture
TsNII	All-Union Central Scientific Research Institute
TsNTL	Central Scientific and Technical Laboratory
VASKhNIL	All-Russian Lenin Academy of Agricultural Sciences
VIG	All-Union Institute of Helminthology
VIEM	All-Union Institute of Experimental Medicine
VIR	All-Union Institute of Plant Cultivation
VIUAA	All-Union Institute of Fertilizers, Soil Science, and Agricultural Engineering
VIZR	All Union Plant-Protection Institute
VNIRO	All-Union Scientific Institute of Fishing and Oceanography
ZIN	Zoological Institute (Academy of Sciences, USSR)

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us. — Editor.